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Central Heating Plant Coal Use Handbook

Volume 2: Coal Specifications Troubleshooting Guide

by
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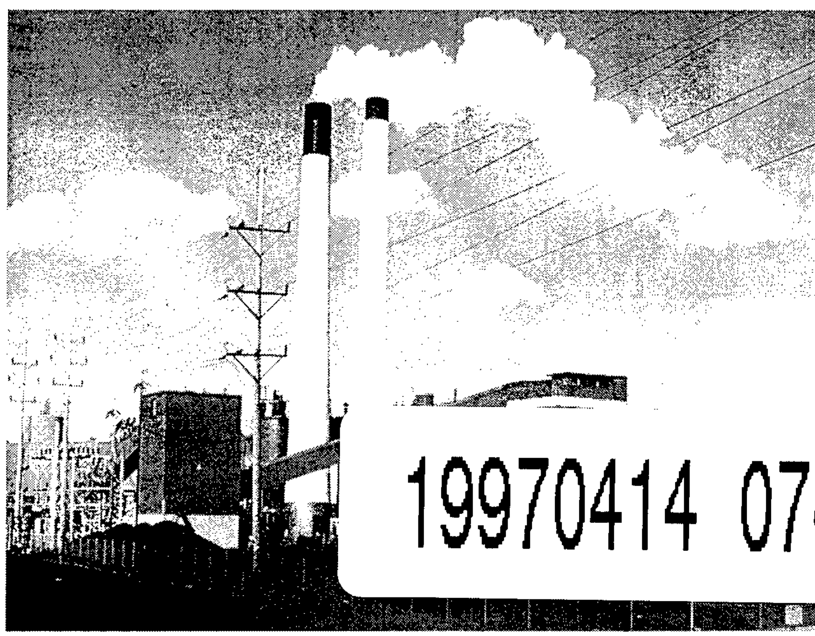

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This Handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The Handbook is tailored for military installation industrial-sized, coal-fired central energy plants. Each section focuses on a different aspect coal quality: developing coal quality-based procurement specifications, measuring and monitoring coal quality throughout the coal use cycle, or identifying and solving boiler coal quality-related problems. The handbook is published in two volumes:

Volume 1: Technical Reference

Volume 2: Coal Specifications Troubleshooting Guide.

Volume 1 is designed as a reference and guide for operations, management, and procurement personnel involved in using coal as a boiler plant fuel. Volume 2 provides logic diagrams to help diagnose and correct 490 specific boiler system problems.

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13. ABSTRACT (Maximum 200 words)

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Foreword

This study was conducted for HQ AFCESA/RA under Military Interdepartmental Purchase Request (MIPR) No. E8787L253. The technical monitor was Freddie Beason, AFCESA/CESE.

The work was performed by the Industrial Operations Division (UL-I) of the Utilities and Industrial Operations Laboratory (UL), U.S. Army Construction Engineering Research Laboratories (USACERL). The USACERL principal investigator was Ralph A. Moshage. Walter J. Mikucki is Chief, CECER-UL-I, and John T. Bandy is Operations Chief, CECER-UL. The USACERL technical editor was William J. Wolfe, Technical Resources.

COL James T. Scott is Commander of USACERL, and Dr. Michael J. O'Connor is Technical Director.

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1 Introduction

1.1 Background

The mechanisms involved in the combustion of coal are so complex that it is often difficult for central energy plant personnel to quantify the impact of coal quality on boiler operating and maintenance costs. Since many Defense (DOD) installations employ coal-fired central energy plants, the U.S. Army Construction Engineering Research Laboratories (USACERL) was tasked with developing a Coal Use Handbook for use at DOD installations.

The two-volume handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The information is tailored for military installation industrial-sized coal-fired central energy plants. This volume contains logic diagrams to help diagnose and correct 490 specific boiler system problems.

1.2 Objective

The objective of this study was to gather and publish comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications.

1.3 Approach

This Handbook is designed as a reference and guide for the operations, management and procurement personnel involved in using coal as a boiler plant fuel. The *Central Heating Plant Coal Use Handbook, Volume 2: Coal Specifications Troubleshooting Guide* is composed of three chapters and six appendixes. This volume provides central heat plant operations personnel with a means to diagnose and correct operating and performance problems with boilers and boiler auxiliary equipment that are a direct consequence of as-fired coal quality.

Chapter 2 contains a discussion of the guide's objectives, assumptions and limitations, and organization. Chapter 3 focuses on a discussion of coal quality-related problems. The appendixes to the guide contain logical diagrams to help operations personnel recognize, diagnose, and correct coal quality-related problems that may occur in the following types of coal-fired systems:

- overfeed stoker-fired boiler system
- spreader stoker-fired boiler system
- underfeed stoker-fired boiler system
- top-feed static grate stoker-fired boiler system
- pulverized coal-fired boiler system
- atmospheric fluidized bed boiler system.

1.4 Scope

This handbook provides quality specifications for anthracite, bituminous, subbituminous, and lignite coals. The information presented in the handbook is generalized and does not supersede the instruction manuals that accompany specific equipment.

1.5 Mode of Technology Transfer

It is recommended that the *Central Heating Plant Coal Use Handbook* be distributed to installations with coal fired heating plants, and to procurement personnel at DOD fuel supply centers.

1.6 Metric Conversion Table

The following metric conversions are provided for standard units of measure used throughout this report:

1 ft	=	0.305 m
1 sq ft	=	0.093 m^2
1 sq in.	=	6.45 cm^2
1 cu ft	=	0.028 m^3
1 lb	=	0.453 kg
1 gal	=	3.78 L
1 oz.	=	29.57 mL
1 psi	=	6.89 kPa
°F	=	(°C × 1.8) +32
1 Btu	=	1.055 kJ

2 Troubleshooting Guide Overview

2.1 Purpose

This Coal Specifications Troubleshooting Guide (TSG) addresses identification and solution of coal quality-related problems encountered in operation of military heat plant coal-fired boilers and heaters. (Note that a distinction is frequently made between boilers, which produce steam, and heaters, which produce hot water. However, this Guide uses the term boiler to designate both central heat plant boilers and heaters). Specific TSG objectives are to:

- Provide central heat plant operating personnel with a means to accurately diagnose boiler and boiler auxiliary components operating and performance problems that are a direct consequence of as-fired coal quality. This requires application of procedures for discriminating between operating and performance problems that are due solely or partly to coal quality and problems due to other causes.

- Once a coal quality-related problem is identified, provide plant operating and/or coal purchasing personnel with guidance on how to alter future coal quality specifications to eliminate the identified coal quality problem.

The TSG consists of a short, report-style introduction that describes the general application of troubleshooting procedures, and six Appendixes that deal in detail with specific potential coal quality problems for the following generic boiler types:

- Overfeed Stoker
- Spreader Stoker
- Underfeed Stoker
- Top Feed Static Grate
- Pulverized Coal
- Atmospheric Fluidized Bed Combustor (AFBC).

Throughout the TSG, each boiler type is commonly referred to as a “system” to indicate that the Guide addresses all potential coal quality affected components

associated with an integrated coal-fired central heat plant, and not just the boiler in isolation. The TSG is intended for use with the following types of coal:

- bituminous
- subbituminous
- lignite.

To facilitate in-plant use by operating personnel and applications validation, the TSG has been developed around a series of potential coal quality problem troubleshooting logic diagrams. Each logic diagram deals with a specific boiler system and a specific problem that could be caused by poor coal quality, for example, firing of coal in which one or more coal quality measures is not within specification. The TSG contains 490 such logic diagrams.

A key aspect of each TSG logic diagram is the differentiation between specific operating problem caused by poor coal quality, and problems with causes unrelated to coal quality, such as operation of system components outside of design conditions. Development of diagnostic procedures to resolve such problems-cause differentiation was the most challenging part of TSG development. It remains an area requiring real feedback from actual TSG application. Because of this, it is recommended that the TSG be validated by limited in-plant testing before general release.

The TSG structure and specifically the troubleshooting logic diagrams were developed with the concept of the development of a military central heat plant coal quality specification expert system in mind. Once fully validated, the logic diagrams could easily become a key component of such an expert system.

2.2 Assumptions and Limitations

A typical military heat plant is comprised of many components supplied by a wide range of equipment manufacturers. Wherever practical, this TSG separates individual components into generic classes, ignoring specific manufacturers and models. Due to this simplification, the TSG must be used in conjunction with appropriate operations and maintenance manuals for boilers and boiler components. This TSG is not intended to replace operations and maintenance manuals. The user should view this TSG simply as a tool to identify and resolve coal quality-related problems at the boiler component level.

The TSG assumes that:

1. The central heat plant boilers and their auxiliaries can operate stably at design conditions when as-fired coal is within design specifications.
2. The instrumentation on boilers and auxiliaries functions properly and is calibrated.
3. The central heat plant facility conducts a quality assurance and quality control program for the preparation and analysis of as-fired coal samples.
4. The central heat plant is equipped with properly designed, operated, and maintained as-fired coal samplers, and these samplers are periodically inspected and bias tested by qualified personnel. Any detected sampler problems or sampling biases are promptly corrected.
5. Laboratory analysis of coal is conducted in strict accordance with recommended analytical procedures.

Quality information is the key element in evaluating coal-related boiler problems. Hence, in applying this TSG, the importance of having accurate coal quality information cannot be overemphasized.

2.3 Troubleshooting Guide Organization

This Chapter will familiarize the user with the TSG organization. Each of the six coal-fired boilers covered in the TSG are addressed in separate Appendixess, each having three subsections: "System Description," "Component/Symptom Identification," and "Operation/Coal Quality-Logic Diagrams." All six boiler systems have separate system descriptions, component/symptom identification tables, and TSG logic diagrams. However, are share such common information as coal quality analytical procedures, terminology, references, and bibliography.

2.3.1 System Description

The beginning of each boiler type section includes a general description of that particular boiler system, typical components comprising this system, and the general operation of the system. These systems are simplified and only include the major components that make up a typical system.

2.3.2 Component/Symptom Identification

Following each coal-fired boiler system description is a block flow diagram illustrating major system components. For example, Figure 1 shows the block flow diagram

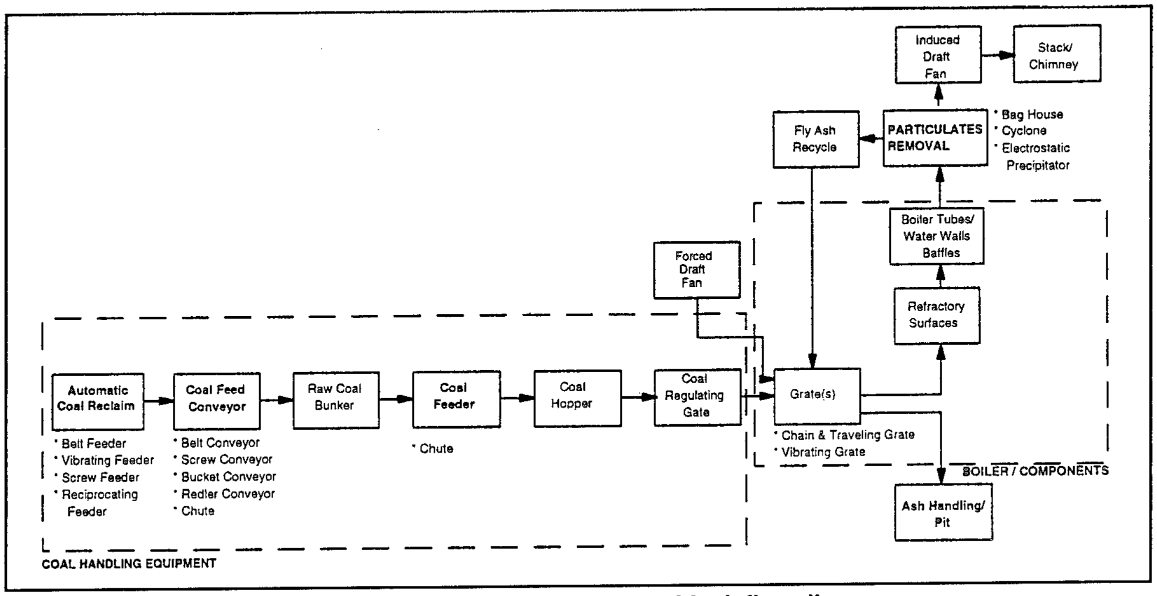

Figure 1. Overfeed stoker-fired boiler system components block flow diagram.

for the overfeed stoker-fired boiler system (as seen in Appendix A, Figure 1-3). The block flow diagram flows from left to right, starting with automatic coal reclaim equipment, which leads to the boiler and finally to the stack/chimney. Items listed next to or under various blocks illustrate particular types of components in the boxes. For example, the coal feed conveyor could be one of the following generic (common) types:

- belt conveyor
- screw conveyor
- bucket conveyor
- redler conveyor
- chute.

Following the system block flow diagram is a component/symptom identification table that identifies typical symptoms (problems) that may be encountered in the components identified in the block flow diagram. Figure 2 (as seen in Appendix A, Figure 1-4) shows the three components/symptoms identification tables for an overfeed stoker boiler. The left side of a table lists typical components required for an overfeed stoker system and the top lists typical symptoms (problems) that may be encountered in these components. For example, if pluggage occurs (defined as little or no coal flow) in the coal feed conveyor and the system uses a screw conveyor, the TSG user would follow the component across and pluggage down as illustrated by the arrows in Figure 3. This results in identification of Figure 4 (also in Appendix A, Figure 1-26). Once the figure number of the troubleshooting logic diagram has been identified, the user goes to that figure and follows the logic diagram.

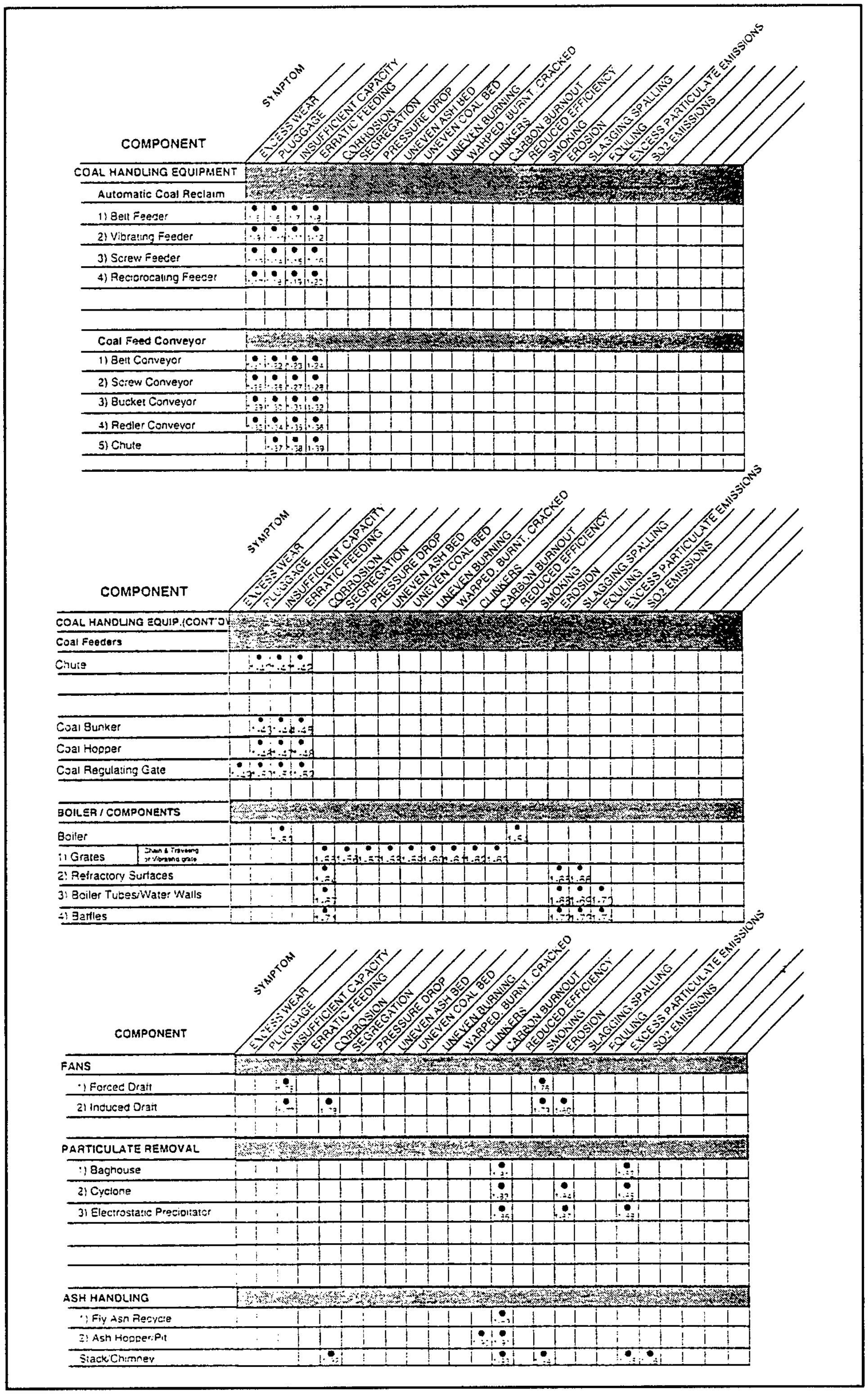

Figure 2. Overfeed stoker—component symptom tables.

OVERFEED STOKER - COMPONENT/SYMPTOM GUIDE

COMPONENT \ SYMPTOM	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																				
Automatic Coal Reclaim																				
1) Belt Feeder	● 1-5		● 1-7	● 1-8																
2) Vibrating Feeder	● 1-9		● 1-11	● 1-12																
3) Screw Feeder	● 1-13		● 1-15	● 1-16																
4) Reciprocating Feeder	● 1-17		● 1-19	● 1-20																
Coal Feed Conveyor																				
1) Belt Conveyor	● 1-21		● 1-23	● 1-24																
2) Screw Conveyor		● 1-26	● 1-27	● 1-28																
3) Bucket Conveyor	● 1-29	● 1-30	● 1-31	● 1-32																
4) Redler Conveyor	● 1-33	● 1-34	● 1-35	● 1-36																
5) Chute		● 1-37	● 1-38	● 1-39																

Figure 3. Overfeed stoker—pluggage in screw conveyor.

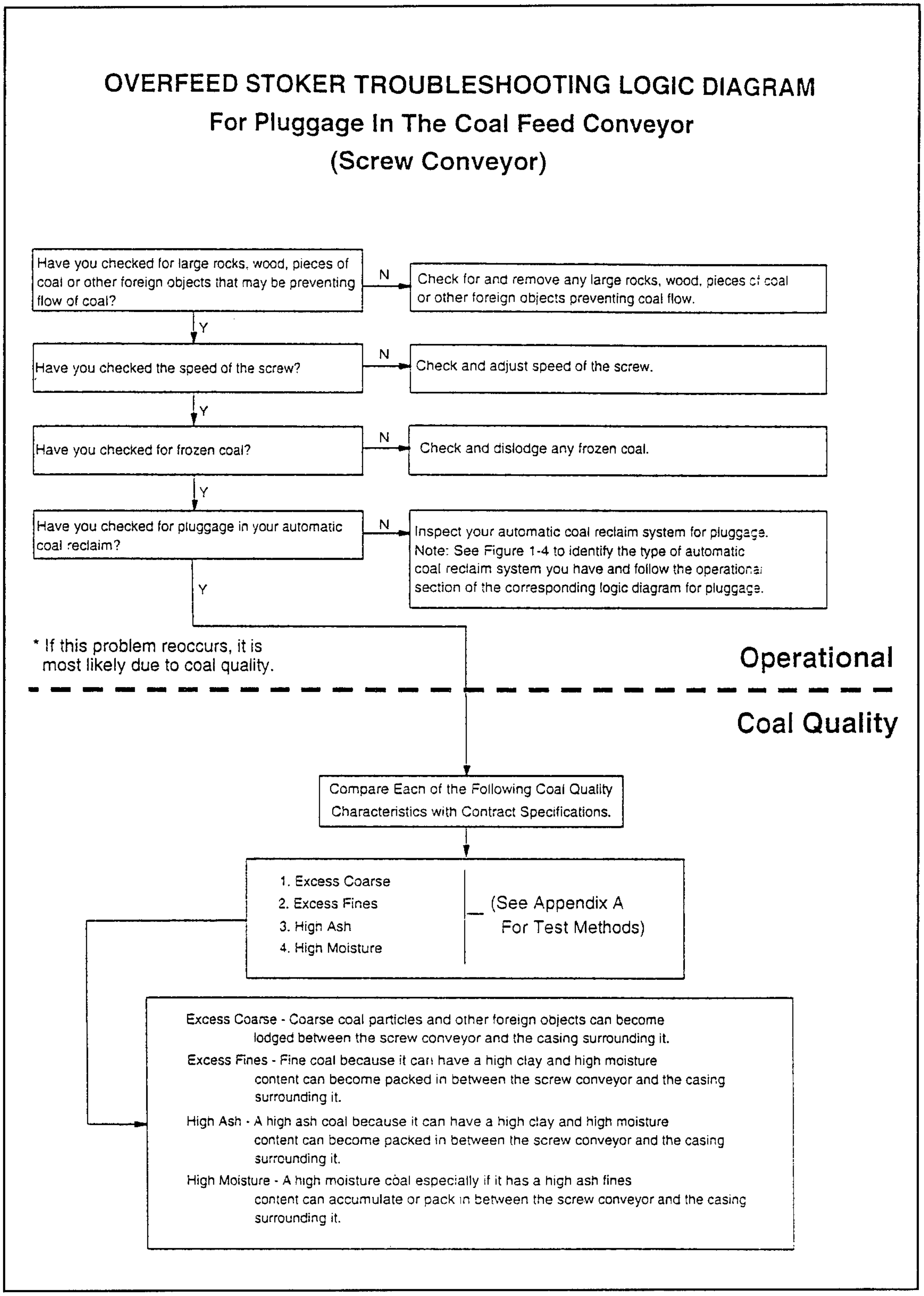

Figure 4. Pluggage in the coal feed conveyor.

2.3.3 *Operation/Coal Quality—Logic Diagrams*

Logic diagrams are "yes and no" type questions that determine if a problem is operational or coal quality related and solutions to those problems. For example, Figure 5 shows a component/symptom guide to isolate coal feed screw conveyor pluggage in overfeed stokers.

Operational problems should be addressed first. Once all operations have been checked, the user should go to the coal quality of the logic diagram. (In Figure 4, the operational part is above the dashed line and the coal quality part is below the dashed line.) The logic diagrams also discuss possible solutions and procedures once a coal quality problem has been located.

Following the Figure 4 logic diagram from top to bottom, the TSG user would answer the following questions in order:

1. Have you checked for large rocks, wood, pieces of coal or other foreign objects that may be preventing flow of coal? If there is blockage then you must remove any large rocks, wood, pieces of coal or other foreign objects preventing the coal flow. If there is no blockage, then proceed down to the next box.
2. Have you checked the speed of the screw? If the answer is no then you must check the speed of the screw conveyor and adjust it, if necessary. Proceed down to the next box if you have already checked and adjusted the speed of the screw and you still have a pluggage problem.
3. Have you checked for frozen coal? If you find frozen coal in your screw conveyor you must heat it. If this still does not solve your pluggage problem, then proceed down to the next box.
4. Have you checked for pluggage in your automatic coal reclaim? If you have already checked coal reclaim for pluggage and there is no pluggage, proceed down to the logic diagram to the coal quality part. Assume the answer is no, you have not checked your automatic coal reclaim for pluggage. Next, you would refer back to the component/symptom identification table (Figure 2) to identify the type of automatic coal reclaim system that you have. Assume you have a vibrating feeder as an automatic coal reclaim, then you would follow the Vibrating Feeder component to Pluggage, as illustrated by the arrows in Figure 5. This identifies the logic diagram that appears in Appendix A, Figure 1-10 (reproduced here as Figure 6).

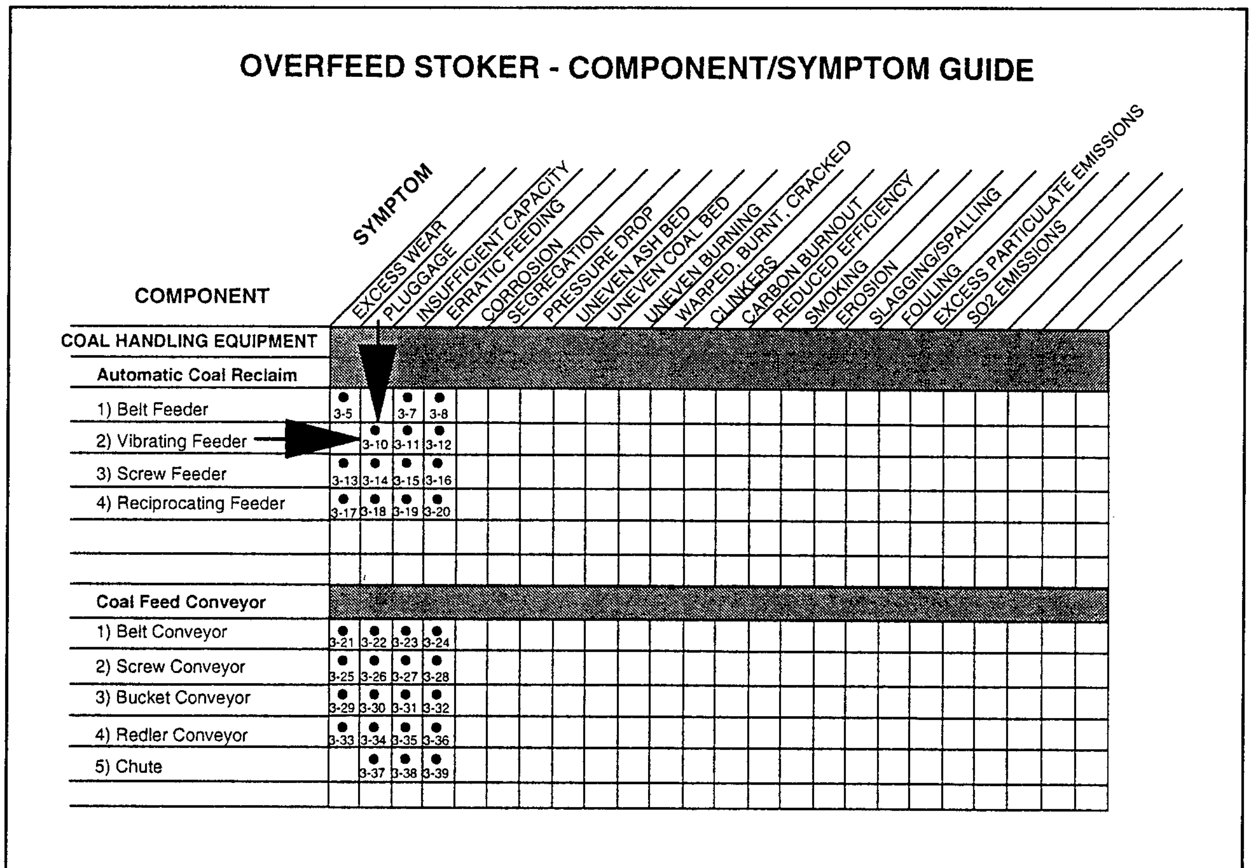

Figure 5. Overfeed stoker—pluggage in vibrating feeder.

Again, following the logic diagram from top to bottom, the user would answer the following questions in order:

1. Have you checked the intensity of vibrations being sent by the feeder?
2. Have you checked for broken or worn out springs?
3. Have you checked for fine damp coal packed in the feeder?
4. Have you checked for large rocks, wood, or pieces of coal lodged in the feeder?

If the answer to all four questions is yes, the vibrating feed is assumed to not be plugged. Since this is the answer for the last question in the Screw Conveyor Logic diagram (Figure 4), the user would return to the Screw Conveyor logic diagram. Since now all Screw Conveyor logic diagram questions are answered yes (Y), the user proceeds to the coal quality part of the logic diagram.

The coal quality measures identified in the coal quality part of Figure 4 are listed in order of likelihood of causing the problem. A representative coal sample would be obtained and analyzed for these measures.

Appendixes A to F contain information regarding each specific boiler system. Following the appendixes, information common to each of the boiler types is listed: typical boiler and auxiliary equipment definitions, abbreviations and acronyms, and references.

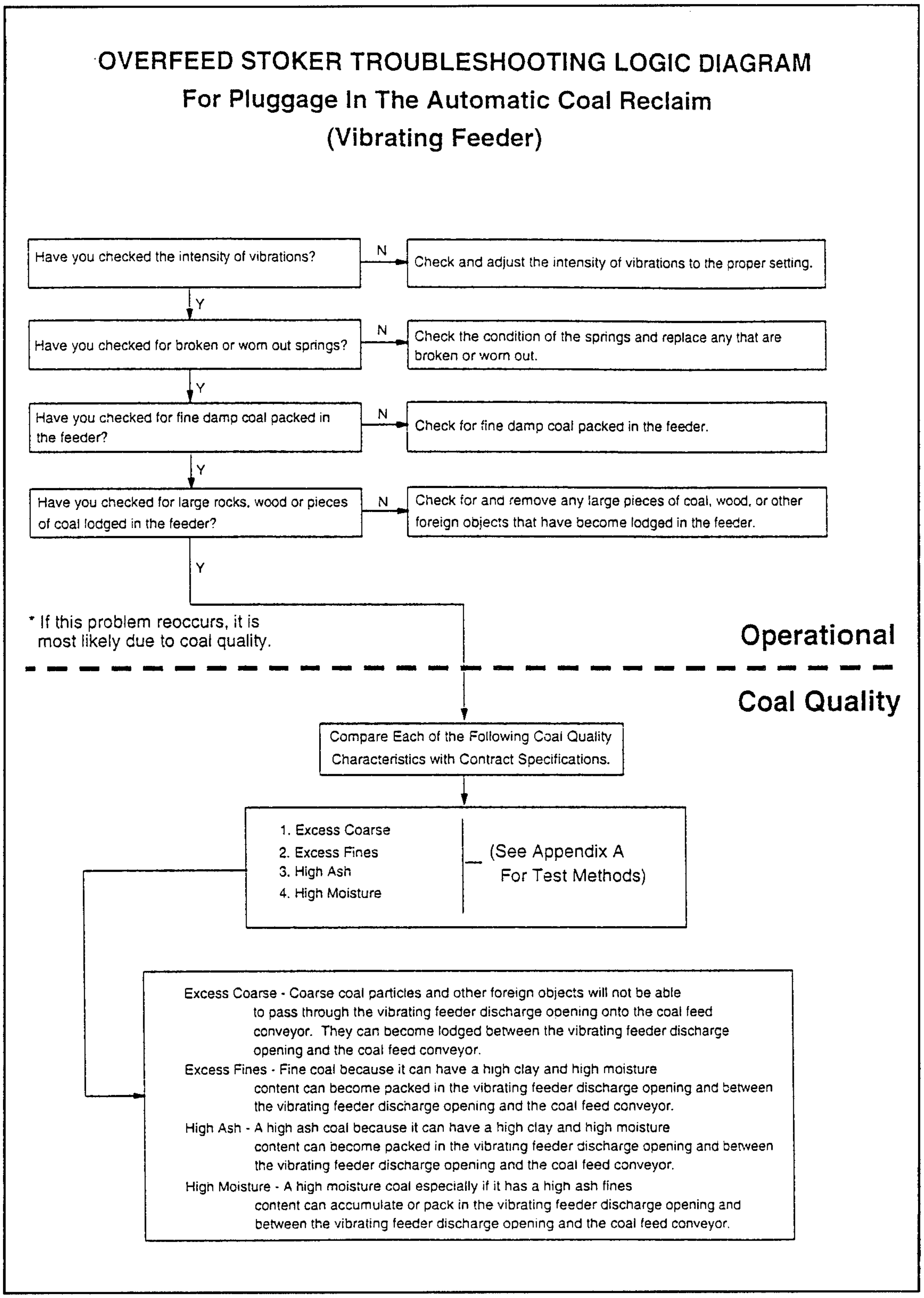

Figure 6. Pluggage in the vibrating feeder.

3 Coal Quality Related Problems

3.1 Coal Quality Definitions

Coal quality is defined in terms of properties such as size consist, heating value, moisture content, sulfur content, ash content, and ash-producing mineral impurities (clay, shale, slate, quartz, and pyrite). Unique to different coal types, these properties affect the following parameters used to measure power plant performance:

- capacity
- heat rate (efficiency)
- availability
- maintenance.

Typically, plant management strives to optimize plant performance by minimizing operating costs. The following operating costs are affected by coal quality:

- coal costs (which are a function of coal quality)
- transportation costs
- plant operating and maintenance costs
- plant performance costs (availability, efficiency, and capacity).

Additional costs associated with the purchase of higher quality coals must be at least offset by savings in transportation costs, operating and/or maintenance costs, and/or improved plant performance. Unfortunately, these trade-offs are difficult to quantify given the small amount of data available on the affect of coal quality on hoppers, grates, boiler tubes, fans, etc. Coal quality may affect plant operations and performance in ways that are still unknown, and most importantly, there is still difficulty in accurately measuring coal quality.

This TSG uses the following coal properties to measure coal quality:

- moisture content
- ash content
- sulfur content
- heating value

- volatile matter
- size consist (specifically coarse and fine sizes)
- free swelling index
- free alkali
- fixed carbon
- ash fusion temperatures
- abrasion
- flyash resistivity
- chlorine content
- flyash erosivity
- hardgrove grindability index
- relative free quartz.

Generating steam or hot water by firing coal that does not meet design specifications can cause many problems. For example:

1. *Moisture*. Moisture can increase coal transportation costs. Moisture allowed to freeze can reduce capacity and cause pluggage in coal storage bunkers and hoppers. Moisture can cause erratic feeding from stoker feeder mechanisms. During combustion, moisture trapped in the coal is vaporized reducing furnace performance.
2. *Ash*. Ash constituents existing in poorly adjusted furnace temperatures can cause clinkering on grates, as well as slagging, fouling, corrosion, and erosion of boiler components such as refractory surfaces, boiler tubes and water walls, and forced and induced draft fans. Tuyeres (grate openings), on the other hand, depend on a covering of ash to protect them from furnace heat. Low ash coal may not provide adequate protection for these surfaces, resulting in outages and excessive maintenance.
3. *Sulfur*. Sulfur can corrode boiler components. In many situations, it must be removed to meet environmental regulations.
4. *Volatile Matter*. Volatile matter affects flame temperature. Excess volatile matter can cause furnace smoking. Molten ash generated by excess volatile matter can cause slagging on heat transfer surfaces. Low volatile matter coal can increase operating costs by requiring oil or gas co-firing to maintain ignition.
5. *Size Consist*. When fired using a poorly adjusted air supply, a coal containing a high percentage of fine particles can lead to carbon carry-over in the flyash, combustible heat loss, burnt stoker grate links, and a pressure drop across the grate.

6. *Ash Fusion Temperatures*. Ash fusion temperatures describe the temperatures at which ash particles liquefy. Molten ash particles adhere readily to heat transfer surfaces, causing slagging and fouling.
7. *Grindability*. Grindability affects pulverizer capacity and auxiliary power consumption.

Improving coal quality can:

- reduce coal transportation and handling costs
- decrease plant maintenance
- reduce plant sulfur dioxide and particulate emissions
- increase power plant efficiency and availability
- reduce heat cost.

Noted that these coal quality benefits can only be realized after an operator has determined that problems encountered in the plant are in fact due to the quality of purchased coal and not to the manner in which the plant is being operated (i.e., insufficient air, poorly adjusted dampers, improper grate speed, improper coal regulating gate setting, etc.).

3.2 How To Diagnose Coal Quality Problems

On discovering a problem in plant operations, the operator should check to see if the plant is operating within design conditions and if the coal quality meets design specifications (as listed in the plant operating manual). If both conditions hold true, the operator should refer to this TSG.

The following example demonstrates proper use of this guide. Suppose the plant operator senses a steam pressure drop and reacts by increasing the stoker coal feed rate to increase heat generation. The operator then notes that the temperature within the furnace actually drops. Furthermore, on visual inspection of the furnace, the operator sees only a small amount of burning coal on the grate. The operator is likely to suspect that the problem is due to an inadequate coal supply reaching the boiler.

At this point, the operator should refer to the TSG's Component/Symptom Tables that correspond to an overfeed stoker fired boiler (Figure 2). Using these tables, the operator should match the symptom to the likely component and proceed to the figure number indicated (Figure 3). The operator is directed to the operational part of a logic diagram that formalizes his inspection of the coal feed conveyor for

pluggage (see Figure 4). The series of questions posed in the diagram focus are by no means exhaustive, but they can serve to help isolate the source of the problem. Throughout the investigation, the operator is encouraged to refer to operations manuals as well as to check other operating parameters that may be causing or worsening the problem.

If the problem still persists after completing the operational part of the logic diagram, the TSG assumes the problem to be coal quality related. The operator should then proceed to the coal quality portion of the logic diagram. Here the operator is presented with a list of coal quality characteristics ordered according to the likelihood of that quality is causing the specific problem. The operator should sample the coal and, in addition, obtain a representative coal sample for lab analysis (either by a commercial or in-house lab). In some cases, it may be more economical to analyze a sample for more than one characteristic. For example, instead of requesting a moisture analysis only, the operator may request a Proximate Analysis, which tests for moisture, volatile matter, fixed carbon, heating value, and ash content.

3.3 How To Solve Coal Quality Problems

The results of the lab analysis of the coal should be checked against the coal quality specifications in the plant's coal contract. For example, if the contract calls for delivered coal to have an ash content of 5 percent (minimum) to 10 percent (maximum), and the lab analysis indicates 8 percent ash, then delivered coal meets the contract specifications. This procedure of sampling, lab analysis, and cross-referencing these results with contract specifications should be followed for each coal quality characteristic. For each coal quality characteristic not meeting contract specifications, the operator is advised to inform the supplier that delivered coal is of unacceptable quality.

If it turns out that all coal quality characteristics meet contract specifications, but problems still persist, the operator should consider that the problem may be caused by coal quality variability. Coal quality variability describes the degree to which the measures of coal quality vary among the particles of a single coal sample. Because coal tests estimate average values, it is possible for a coal sample having a large variability to satisfy coal quality specifications and still cause operating problems. For example, if an isolated batch of coal having a higher than average moisture content enters the feeder as a group, it might cause the feeder to plug. Coal quality variability can usually be detected by repeat sampling and analysis. Multiple tests increase the likelihood that some of the results will depart significantly from the others. However, in certain situations, it is difficult to detect coal variability. In

such situations, special sampling (and sometimes special analytical) techniques are required. If coal quality variability is a potential problem, it is recommended that outside help be obtained from fuel specialists. Such information can be obtained from USACERL, or from commercial coal laboratories.

If coal specifications are satisfied and the coal quality variability is acceptable, then the operator should consult the boiler manufacturer regarding proper coal specifications.

4 Conclusion

This study has gathered and presented comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications.

The two-volume handbook provides comprehensive information on how to minimize coal-fired central heat plant operations cost by improving coal quality specifications. The information is tailored for military installation industrial-sized coal-fired central energy plants. Volume I is designed as a reference and guide for the operations, management, and procurement personnel involved in using coal as a boiler plant fuel. This volume contains logic diagrams to help diagnose and correct 490 specific boiler system problems.

Glossary

Absolute pressure: Pressure above zero pressure, the sum of the gauge and atmospheric pressures.

Acid dew point: The temperature at which an acid in vapor form condenses into liquid form. specifically sulfuric acid in flue gas leaving an FGD system.

Agglomerating: The characteristic of a coal that causes coking on the fuel bed during volatilization.

Air distributor: A plate, grid or pipe containing either perforations, nozzles, or bubble caps, which serves as a means of evenly distributing combustion/fluidizing air to support a fluidized bed.

Air-fuel ratio: The ratio of the weight, or volume of air to fuel.

Air preheater or air heater: A heat exchanger that transfers heat from a high temperature medium such as hot gas, or steam, to an incoming air stream.

(a) **regenerative air preheater**: A heat exchanger having heat exchanger surface that is alternatively exposed to hot exhaust gas and incoming ambient air. Heat is absorbed from the outgoing hot gas stream and subsequently released from the same surfaces to the incoming air stream.

(b) **recuperative air header**: A static air header in which the air and gas flows are separated by the heat transfer medium.

(c) **tubular air header**: contains bundles of heat transfer tubes that allow either fluid to flow through the tubes while the other fluid flows around and between the tubes.

(d) **plate air header**: An air header containing passages formed by spaced plates through which heat is transferred from a flowing heating medium to an air stream.

Air, saturated: Air that contains the maximum amount of water vapor that it can hold at its temperature and pressure.

Air-transport system: A fuel transport system using air as the conveying medium.

Analysis, proximate: Analysis of solid fuel stating moisture content, volatile matter, fixed carbon, heating value and ash content expressed on a percent by weight basis.

Analysis, ultimate: Chemical analysis of a fuel stating carbon, hydrogen, sulfur, nitrogen, chlorine, oxygen, and ash content expressed on a percent by weight basis.

Anthracite coal: A high ASTM ranked coal with dry fixed carbon 92 percent or more and less than 98 percent; and dry volatile matter 8 percent or less and more than 2 percent on a mineral-matter-free basis.

Arch firing: Method of firing in which burners are placed in a furnace arch and directed downward.

Arch-furnace: A horizontal structure extending into the furnace, to serve as a deflector of the gases and act as a radiant reflector.

Arch -roof: A structure composed of refractory, or combination of refractory and water tubes, enclosing the furnaces combustion chamber at the top.

As-fired fuel: Fuel in the condition as fed to the fuel burning equipment.

Ash: The incombustible inorganic matter in the fuel; i.e., the mass remaining after all combustible matter has been consumed.

Ash-bed: A layer of refuse left on grates or deposited on a furnace floor after the fuel is burned.

Ash fusion (temperatures): The temperatures at which a cone of coal or coke ash exhibits certain melting characteristics. See ASTM-DI857.

Ash gate: A gate or valve through which refuse is removed from an ash pit or soot hopper.

Ash pit: A pit or hopper located below a furnace where refuse is accumulated and from which it is removed at intervals.

Ash: The incombustible solid matter in fuel.

Ash-free basis: The method of reporting fuel analysis whereby ash is deducted and other constituents are recalculated to total 100 percent.

Baffle: A plate or wall for deflecting gases or liquids.

Bag filter: A device containing one or more cloth bags for recovering particles from the dust laden gas or air that is blown through.

Baghouse: An air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags usually made of glass fibers.

Balanced draft: The maintenance of a fixed value of draft in a furnace at all combustion rates by control of incoming air and outgoing products of combustion.

Banking: Burning solid fuel on a grate at rate sufficient to maintain ignition only.

Banking (live): Burning solid fuel on a grate in a boiler at a combustion rate just sufficient to maintain normal operating pressure under conditions of no steam/water load demand.

Barley: Anthracite coal size: No. 3 (Barley): through 3/16-in., over 3/32-in. round mesh screen.

Base/acid ratio: Total weight of the basic constituents in coal ash divided by the total weight of the acid constituents. Bases normally considered are the oxides of iron, sodium, calcium, magnesium and potassium. Acids are silicon, aluminum and titanium.

Base load: Base load is the term applied to that portion of a station or boiler load that is practically constant for long periods.

Bed material: Granular particles that compose the fluidized bed.

Bed moisture: The moisture in coal when in the seam.

Bin system: A system in which fuel is pulverized, stored in bins, and subsequently withdrawn through feeders to the burners in amounts sufficient to satisfy load demands.

Bituminous coal: ASTM coal classification by rank on a mineral-matter-free basis and with bed moisture only.

Low Volatile: Dry fixed carbon 78 percent or more and less than 86 percent; and dry volatile matter 22 percent or less and more than 14 percent.

Medium Volatile: Dry fixed carbon 69 percent or more and less than 78 percent; and dry volatile matter 22 percent or less and more than 31 percent.

High Volatile (A): Dry fixed carbon less than 69 percent and dry volatile matter more than 31 percent: Btu value equal to or greater than 14,000 moist, mineral- matter-free basis.

High Volatile (B):: Btu value 13,000 or more and less than 14,000 moist, mineral-matter-free basis.

High Volatile (C): Btu value 11,000 or more and less than 13,000 moist, mineral-matter free basis commonly agglomerating, or 8,300 to 11,500 Btu agglomerating.

Blowdown: Removal of a portion of boiler water for the purpose of reducing solids concentration, or to discharge sludge.

Blower: The fan used to force air through a pulverizer or to force primary air through an oil or gas burner register.

Boiler: A closed vessel in which water is heated, steam is generated, steam is superheated, or any combination thereof, under pressure or vacuum by the application of heat. The term does not include such facilities that are an integral part of a continuous processing unit but shall include units supplying heating or vaporizing liquids other than water where these units are separate from processing systems and are complete within themselves.

Watertube: A boiler in which the tubes contain water and steam, the heat being applied to the outside surface.

Bent tube: A watertube boiler consisting of two or more drums connected by tubes, practically all of which are bent near the ends to permit attachment to the drum shell on radial lines.

Horizontal: A watertube boiler in which the main bank of tubes are straight and on a slope of 5 to 15 degrees from the horizontal.

Scotch boiler: A cylindrical steel shell with one or more cylindrical internal steel furnaces located (generally) in the lower portion and with a bank or banks (passes) of tubes attached to both end closures.

In Stationary Service, the boilers are either of the Dry-Back, or Wet-Back Type (See Boiler Dry-Back and Boiler Wet-Back). In Marine Service, the boilers are generally of the Wet-Back Type (See Boiler Wet-Back).

Boiler convection bank: A group of two or more rows of tubes forming part of a water boiler circulatory system and to which heat is transmitted mainly by convection from the products of combustion.

Boiler efficiency: The ratio of the net energy output of the boiler fluid divided by the input of the primary energy source(s).

Boiler, high-pressure: a boiler furnishing steam at pressure in excess of 15 pounds per square inch (psi) (103 422 Pa) or hot water at temperatures in excess of 250°F (121°C) or at pressures in excess of 160 psi (1 103 168 Pa).

Boiler, high-temperature hot water: A water heating boiler operating at a pressure exceeding 160 psig (1 103 168 Pa) or temperatures exceeding 250°F (121°C).

Boiler horsepower: The evaporation of 34 ½ lbs (15.648 kg) of water per hour from a temperature of 212°F (100°C) into dry saturated steam at the same temperature. Equivalent to 33,472 Btu/hr (35291 203.20 joule).

Boiler, low-pressure hot-water and low-pressure steam: A boiler furnishing hot water at pressures not exceeding 160 psi (1 103 168 Pa) or at temperatures not more than 250°F (121°C) pr steam at pressures not more than 15 psi (103 422 Pa).

Boiler slag screen: A screen formed by one or more rows of widely spaced tubes constituting part of, or positioned in front of, a watertube boiler convection bank, and functioning to lower the temperature of the products of combustion and to serve as an ash cooling zone.

Boiler wet-back: A baffle provided in a firetube boiler or water leg construction covering the rear end of the furnace and tubes, and is completely water cooled. The products of combustion leaving the furnace are turned in this area and enter the tube bank.

Bone coal: Coal from that part of a seam that has a very high ash content. In connection with anthracite, any material that has 40 percent, or more, but less than 75 percent fixed carbon.

Breeching: A duct for the transport of the products of combustion between parts of a steam generating unit and the stack.

Bridgewall: A wall in a furnace over which the products of combustion pass.

Bridging: The accumulation of ash and slag partially or completely blocking spaces or orifices between heat absorbing tubes.

British thermal unit: The mean British Thermal Unit is 1/180 of the heat required to raise the temperature of 1 lb of water from 32°F to 212°F at a constant atmospheric pressure. It is about equal to the quantity of heat required to raise 1 lb of water 1 °F. (251.9957 calories or 1054.35 joule).

Broken coal: Anthracite coal size-through 4 3/8-in., over 3 1/4-in. round mesh screen.

Brown coal: A former coal classification according to rank now included in lignite B.

Bubbling bed: A fluidized bed in which the fluidizing velocity is less than the terminal velocity of individual bed particles where part of the fluidizing gas passes through the bed as bubbles.

Buckwheat: Anthracite coal size: No. 1 (Buckwheat): through 9/16-in., over 5/16-in. round mesh screen.

Burner: A device for the introduction of fuel and air into a furnace at the desired velocities, turbulence and concentration to establish and maintain proper ignition and combustion of the fuel.

(a) **automatic burner**: A burner that stops and starts automatically.

(b) **burner, automatically ignited**: A burner having its main fuel automatically turned on and ignited (See section L).

(c) **burner, manually ignited**: A burner having its main fuel turned on only by hand and ignited under supervision (See section L).

(d) **burner, forced draft**: A burner where air for combustion is supplied above atmospheric pressure.

(e) **burner, natural draft type**: A burner that depends principally upon the natural draft to induce the air required for combustion.

Burner windbox: A plenum chamber around a burner in which air pressure is maintained to insure proper distribution and discharge of secondary air.

Burner windbox pressure: The air pressure maintained in the windbox or plenum chamber.

Bus section: The smallest portion of the precipitator that can be independently de-energized (by subdivision of the high voltage system and arrangement of support insulators).

Bypass temperature control: Control of vapor or air temperature by diverting part or all of the heating medium from passing over the heat absorbing surfaces, usually by means of a bypass damper.

Caking: Property of certain coals to become plastic when heated and form large masses of coke.

Calcium sulfate: A solid, relatively insoluble material, with a chemical formula of CaSO4, the by-product of some FGD systems, normally formed by oxidation of Calcium Sulfite. Commonly produced as Calcium Sulfate Dihydrate, $CaSO_4 . 2H_2O$, also known as gypsum.

Calorific value: The number of heat units liberated per unit of quantity of a fuel burned in a calorimeter under prescribed conditions.

Calorimeter: Apparatus for determining the calorific value of a fuel.

Capacity: The manufacturers stated output rate over a period of time for which the boiler is designed to operate.

Capacity factor: The total output over a period of time divided by the product of the boiler capacity and the time period.

Carbon (Element): The principal combustible constituent of most fuels.

Carbonization: The process of converting coal to carbon by removing other ingredients.

Carbon loss: The unreleased chemical energy due to incomplete oxidation of the carbon in the fuel.

Carbon residue: The quantity of the carbonaceous material remaining after the volatile compounds are vaporized.

Carryover: The chemical solids and liquid entrained in the steam leaving the boiler.

Chain grate stoker: A stoker that has a moving endless chain as a grate surface, onto which coal is fed directly from a hopper.

Chimney: A brick, metal or concrete stack.

Cinder: Particles of partially burned fuel from which volatile gases have been driven off, which are carried from the furnace by the products of combustion.

Cinder-catcher: Apparatus for separating and collecting cinders from the products of combustion (see also Flyash Collector, Dust Collector, or Precipitator).

Cinder-return: Apparatus for the return of collected cinders to the furnace, either directly or with the fuel.

Clinker: A hard compact congealed mass of fuel matter fused in the furnace, usually slag.

Clinkering: The formation of clinkers.

Clinker grinder stoker: One in which the refuse is discharged into a pit containing at the bottom, one or more grinding rolls that are continuously or intermittently operated to produce a positive discharge of crushed refuse to the ash pit.

Coal: Solid hydrocarbon resulting from the decomposition of vegetal material under the influence of time, temperature, pressure and micro-organisms.

Coal-burner: A burner for use with pulverized coal.

Collecting system: The grounded portion of the precipitator to which the charged dust particles are driven and to which they adhere.

Collecting surfaces: The individual elements that make up the collecting system and that collectively provide the total area of the precipitator for the deposition of dust particles.

Collecting surface rapper: A device for imparting vibration or shock to the collecting surface to dislodge the deposited particles or dust.

Collecting surface area: The total flat projected area of collecting surface exposed to the active electrostatic field (length x height x 2 x number of gas passages).

Collection efficiency: The weight of dust collected per unit time divided by the weight of dust entering the precipitator during the same unit time expressed in percentage.

Collection efficiency: The percentage of sulfur dioxide collected by an FGD system, calculated by dividing the weight of sulfur dioxide collected by the system by the weight of sulfur dioxide entering the system and multiplying by one hundred percent. Also extends to particulate collection.

Combustible: The heat producing constituents of a fuel.

Combustible in ash: Combustible matter in the solid ash resulting from the incomplete combustion of fuel.

Combustible loss: The unreleased chemical energy due to incomplete oxidation of the combustible matter in the fuel.

Combustion chamber: An enclosed space provided for the combustion of fuel.

Commercial boiler: A boiler that produces steam or hot water primarily for heating in commercial applications with incidental use in process applications. Commercial boilers come in a wide range of types, sizes, capacities, pressures and temperatures. They may also be supplied for more than one application.

Complete combustion: The complete oxidation of all the combustible constituents of a fuel.

Convection: The transmission of heat by the circulation of a liquid or a gas such as air. Convection may be natural or forced.

Convection heating surface: Heating surface over or through which hot combustion gases flow to transfer heat primarily by convection. (See Heating Surface, Section G.).

Corrosion: The wasting away of metals due to chemical action in a boiler usually caused by the presence of H_2, O_2, CO_2, an acid or strong alkalies.

Cyclone: A stationary centrifugal type separator used to separate pulverized fuel from pulverizer air in storage system.

Cyclone collector: A device that uses centrifugal force to pull large particles from polluted air.

Cyclone furnace: Specialty furnace for high intensity heat release. So named because of its swirling gas and fuel flows.

Damper: A device for introducing a variable resistance for regulating the volumetric flow of gas or air.

(a) **butterfly type**: A single blade damper pivoted about its center.
(b) **curtain type**: A damper, composed of flexible material, moving in a vertical plane as it is rolled.
(c) **flap type**: A damper consisting of one or more blades, each pivoted about one edge.
(d) **louvre type**: A damper consisting of several blades, each pivoted about its center and linked together for simultaneous operation.
(e) **slide type**: A damper consisting of a single blade that moves substantially normal to the flow.

Damper loss: The reduction in the static pressure of a gas flowing across a damper.

Damper control: See Bypass Temperature Control.

Design load: The load for which a steam generating unit is designed, usually considered the maximum load to be carried.

Design pressure: The pressure used in a design of a boiler for the purpose of determining the minimum permissible thickness or physical characteristics of the different parts of the boiler.

Design steam temperature: The temperature of steam for which a boiler, superheater or reheater is designed.

De-slag: The removal of slag that has adhered to heat absorbing surfaces.

Dew point: The temperature at which condensation starts.

Direct-fired boiler: Commonly used to denote a boiler and furnace fired by pulverized coal directly from the pulverizing mills.

Draft: The difference between atmospheric pressure and some lower pressure existing in the furnace or gas passages of steam generating unit.

Draft loss: The drop in the static pressure of a gas between two points in a system, both of which are below atmospheric pressure, and caused by resistance to flow.

Dry ash: Non-combustible matter in the solid state, usually in granular dust form.

Dry, ash free basis (daf): The method of reporting fuel analysis with ash and moisture eliminated and remaining constituents recalculated to total 100 percent.

Dry bottom furnace: A pulverized-fuel furnace in which ash particles are deposited on the furnace bottom in a dry, non-adherent condition.

Dry, fuel basis (d): The method of reporting fuel analysis with moisture eliminated and other constituents recalculated to total 100 percent.

Dry, mineral-matter-free basis (dmmf): The method of reporting fuel analysis with moisture and ash, plus other mineral matter eliminated and remaining constituents recalculated to total 100 percent.

Dry steam: Steam containing no moisture. Commercially dry steam containing not more than one half of one percent moisture.

Dulong's formula: A formula for calculating the approximate heating value of solid fuels from the ultimate analysis.

Dust collector: A device designed to remove flyash in dry form from flue gas (See also Cinder-Catcher and Flyash Collector.).

Dust loading: The weight of solid particulate suspended in an air (gas) stream, usually expressed in terms of grains per cu ft, grams per m^3 or lb/1000 lb of gas.

Economizer: A heat recovery device designed to transfer heat from the products of combustion to boiler feedwater.

Efficiency: The ratio of output to the input. The efficiency of a steam generating unit is the ratio of the heat absorbed by water and steam to the heat in the fuel fired.

Electrostatic precipitator (Esp): An air pollution control device that imparts an electrical charge to particles in a gas stream causing them to collect on an electrode.

Entrainment: The conveying of particles of water or solids from the boiler water by the steam.

Erosion: The wearing away of refractory or of metal parts by the action of slag, flyash or soot blower jet streams.

Erosion: Wearing away due to mechanical action.

Excess air: Air supplied for combustion in excess of that theoretically required for complete oxidation.

Fabric filter: A cloth device that catches dust and particles from industrial or utility emissions.

Fan: A machine consisting of a rotor and housing for moving air or gases at relatively low pressure differentials.

Fineness: The percentage by weight of a standard sample of a pulverized material that passes through standard screen of specified mesh when subjected to a prescribed sampling and screening procedure (ASTM D 197).

Fines: Commonly the percentage of coal that passes through a 1/4-in. screen.

Fixed ash: The portion of the ash derived from the original vegetation including all intimately contained minerals.

Fixed carbon: The carbonaceous residue less the ash remaining in the test container after the volatile matter has been driven off in making the proximate analysis of a solid fuel.

Flue gas: The gaseous products of combustion in the flue to the stack.

Flue gas desulfurization (fgd): A method of controlling sulfur dioxide emissions by removing the sulfur compounds from the flue gas after combustion.

Fluidized: The act of blowing air or gas through a bed of finely divided solid particles at such a velocity that the particles separate and behave much like a fluid.

Fluidized bed: A process where a bed of granulated particles are maintained in a mobile suspension by an upward flow of air or gas.

Fluidized bed boiler: A boiler using a fluidized bed combustion process.

Fluidized bed combustion: A process where a fuel is burned in a bed of granulated particles that are maintained in a mobile suspension by the forward flow of air and combustion products.

Flyash: Suspended ash particles carried in the flue gas.

Flyash collector: A device designed to remove flyash in dry form from the flue gas. (See also Dust Collector or Cinder-Catcher.).

Forced draft fan: A fan supplying air under pressure to the fuel burning equipment.

Fouling: The accumulation of solid matter in gas passages or on heat absorbing surfaces that results in undesirable restrictions to the flow of gas or heat. The entrapment of incombustible ash particles in the solidified (condensed) mineral matter adhering to tube surfaces.

Free ash: Ash that is not included in the fixed ash.

Grindability: A characteristic of a coal relating to the ease of its pulverization. The grindability index of a standard selected coal was given the factor 100. Coals harder to grind have a lower index number. The index is a factor in pulverizer selection.

Hardness: A measure of the amount of calcium or magnesium salts in a boiler water. Usually expressed as grains per gallon or ppm as $CaCO_2$.

Heat exchanger: A vessel in which heat is transferred from one medium to another.

Hemispherical temperature: A fusion temperature at which a standard ash cone when heated in accordance with a prescribed procedure (ASTM-1857) has fused down to a hemispherical lump at which point the height is one-half the width of the base (H=1/2W).

Higher heating value: The total heat obtained from the combustion of a specified amount of fuel that is at 60 °F when combustion starts, and the combustion products of which are cooled to 60 °F before the quantity of heat released is measured.

Hopper: A charger or bin used for holding coal or refuse.

Hopper capacity: The total volumetric capacity of hoppers measured from a plane 10 in. below high voltage system to hopper outlet flange.

Ignition arch: A refractory arch, or surface, located over a fuel bed to radiate heat and promote continued ignition.

Ignition temperature: Lowest temperature of a fuel at which combustion becomes self-sustaining.

Incomplete combustion: The partial oxidation of the combustible constituents of a fuel.

Induced draft fan: A fan supplying air under pressure to the fuel burning equipment.

Industrial boiler: A boiler that produces steam or hot water primarily for process applications for industrial use with incidental use for heating. Industrial boilers cover a wide range of sizes, capacities, pressures, and temperatures. They may also be supplied for more than one application (cogeneration, etc.).

Lignite A: A coal of low ASTM ranking with calorific value limits on a moist, mineral-matter-free basis between 6,300 and 8,300 Btu/lb.

Lignite B: A coal of lowest ASTM ranking with calorific value limits on a moist, mineral-matter-free basis less than 6,300 Btu/lb.

Lime: Calcium oxide (CaO), a chemical used in some FGD systems that is mixed with water from calcium hydroxide ($Ca(OH)_2$).

Limestone: Calcium carbonate (CaCO3), a chemical used on some FGD systems.

Liquid slag: Slag in a fluid state.

Load: The actual instantaneous output rate of a boiler.

Load factor: See Capacity Factor.

Maximum continuous load: See Capacity.

Maximum continuous rating: See Capacity.

Mechanical draft: The negative pressure created by mechanical means.

Mineral-matter-free basis (mmf): The method of reporting coal analysis whereby the ash plus other minerals that are in the original coal are eliminated and the other constituents recalculated to total 100 percent.

Moisture: Water in the liquid or vapor phase.

Moisture and ash-free basis: Method of reporting coal analysis: Dry, Ash Free Basis.

NOx emissions: NO and NO_2 constituents in the boiler exiting flue gas.

Opacity: The degree to which emissions reduce the transmission of light and obscure the view of an object in the background. Usually defined as a percentage between zero and 100 percent. At zero percent, light is completely unobstructed and at 100 percent, light is completely obstructed. (Opacity numbers with respect to boiler emissions are not intended to include the effect of condensing water vapor).

Overfire air: Air admitted to the furnace above a matrix of burners for promoting staged combustion firing, thus reducing NOx formation.

Overfire air fan: A fan used to provide air to a combustion chamber above the fuel bed.

Particulate loading: See dust loading.

Particulates: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in the air or emissions.

Pneumatic conveying: The transportation of fuel through a conduit by air.

Precipitator: A single precipitator is an arrangement of collecting surfaces and discharge electrodes contained within one independent housing.

Precipitators: Air pollution control devices that collect particles from an emission source by mechanical or electrical means.

Preheat air: Air introduced with the fuel at the burners.

Primary air: Air introduced with the fuel at the burners.

Pressure drop: The difference in pressure between two points in a system.

Primary air fan: A fan to supply primary air for combustion of fuel.

Products of combustion: The gases, vapors, and solids resulting from the combustion of fuel.

Proximate analysis: See Analysis, Proximate.

Pulverized fuel: Solid fuel reduced to a fine size, such as 70 percent through a 200 mesh screen.

Pulverized-fuel feeder: An apparatus for the controlled delivery of pulverized fuel from a storage bin.

Pulverizer: A machine that reduces a solid fuel to a fineness suitable for burning in suspension.

(1) **High Speed (over 800 rpm)**

(a) **impact pulverizer**: A machine wherein the major portion of the reduction in particle size of the fuel to be pulverized is effected by fracture of larger sizes by sudden shock, impingement, or collision of the fuel with rotation members and casing.

(b) **attrition pulverizer**: A machine wherein the major portion of the reduction on particle size is by abrasion, either by pulverizer parts on coal, or by coal on coal.

(2) **Medium Speed (between 70 and 300 rpm)**

(a) **roller pulverizer**: A machine having grinding elements consisting of conical or cylindrical rolls and a bowl, bull-ring mating rings, or table, any of which may be the rotating member, the fuel to be pulverized being reduced in size by crushing or attrition between the rolls and the rings.

(b) **ball pulverizer**: A machine in which the grinding elements consist of one or more circular rows of metal balls arranged in suitable raceways, wherein the fuel to be pulverized is reduced in size by crushing and attrition between the balls and raceways.

(3) **Low Speed (under 70 rpm)**

(a) **ball or tube pulverizer**: A machine having a rotating cylindrical or conical casing charged with metal ball or slugs and the fuel to be pulverized, reduction in particle size being effected by crushing and attrition due to continuous relative movement of the charge on rotation of the casing.

Pulverizer air: Air passed through a pulverizer to dry and convey the pulverized fuel to the burners in direct-fired systems, or to cyclones in storage systems (Gas is sometimes used for the same purpose in storage systems).

Pulverizer exhauster: A fan connection to the outlet of a pulverizer and used to draw pulverizer air through a pulverizer and in some cases to augment the pulverizer air by addition of primary air.

Rated capacity: See Capacity.

Refractory: A concrete like material having the ability to retain its physical shape when subjected to high temperatures.

Refractory baffle: A baffle of refractory material.

Refractory wall: A wall made of refractory material.

Rice: Anthracite coal size: No. 2 (Rice): through 5/15-in., over 3/16-in. round mesh screen.

Screw feed: A means of introducing fuel by rotation of a screw.

Scrubber: An apparatus for the removal of solids and objectionable materials from gases.

Secondary air: Combustion air supplied to the furnace to supplement the primary air.

Slag: Molten or fused solid matter.

Slag blower: See Soot Blower.

Slag viscosity: Flow characteristics of coal slags in the plastic region.

Smoke: Small gas borne particles of carbon or soot, less than 1 micron (0.001 mm) in size, resulting from incomplete combustion of carbonaceous materials and sufficient in number to be observable.

Smoke: Particles suspended in air after incomplete combustion of materials containing carbon.

Softening temperature: The temperature at which a standard ash cone fuses down to a spherical mass in which the height is equal to the width of the base when heated in accordance with a prescribed procedure (ASTM D-1857).

Soot: Unburned particles of carbon derived from hydrocarbons.

Soot blower: A mechanical device for discharging steam, air or water to clean heat absorbing surfaces. May be either a fixed-position rotary unit, a retractable soot blower, or a wall blower.

SOx: A notation meaning oxides of sulfur.

Spalling: The breaking off of the surface refractory material as a result of internal stresses resulting from an excessive temperature gradient.

Stack: A vertical conduit that discharges combustion products into the atmosphere. Also known as a chimney or smokestack.

Sub-bituminous coal: An intermediate rank coal between lignite and bituminous with more carbon and less moisture than lignite:

A. Btu 10,000 or more and less then 11,500
B. Btu 9,500 or more and less than 10,500
C. Btu 8,300 or more and less than 9,500.

Superheater: A group of tubes that absorb heat from the products of combustion to raise the temperature of the steam passing through the tubes above its saturation temperature.

(a) **convection superheater**: A superheater so arranged and located to absorb heat from the products of combustion mainly by convection.

(b) **radiant superheater**: A superheater so arranged and located to absorb heat by radiation.

(c) **baretube superheater**: A superheater in which all of the heating surface consists of the external surface of the tubes.

(d) **fin superheater**: A superheater made up of elements with extended surface.

(e) **girth superheater**: A superheater of a horizontal return tubular boiler in which the superheater elements are wrapped partially around the shell.

(f) **interbank superheater**: A superheater located in a space between the tube banks of a bent tube boiler.

(g) **interdeck superheater**: A superheater located in a space between tube banks of a straight tube boiler.

(h) **intertube superheater**: A superheater the elements of which are located between tubes of a boiler convection bank.

(I) **overdeck superheater**: A superheater located above the tube bank of a straight tube boiler.

Surface moisture: That portion of the moisture in the coal that comes from external sources as water seepage, rain, snow, condensation, etc.

Tempering moisture: Water added to certain coals that, as received, have insufficient moisture content for proper combustion on stokers.

Total moisture: The sum of inherent moisture and surface moisture in coal.

Ultimate analysis: See Analysis, Ultimate.

Underfire air: Combustion air delivered to a furnace through openings in furnace wall(s) located below main fuel/combustion air burner openings. Applied to influence thermal NOx development.

Volatile matter: Those products given off by a material as gas or vapor, determined by definite prescribed methods.

Water cooled baffle: A baffle composed essentially of closely spaced boiler tubes.

Water cooled wall: A wall cooled by watertubes.

Windbox: A chamber below the grate or surrounding a burner, through which air under pressure is supplied for combustion of the fuel.

Windbox pressure: The static pressure in the windbox of a burner, firing system or stoker.

Abbreviations and Acronyms

ABMA	American Boiler Manufacturers Association
AFBC	Atmospheric Fluidized Bed Combustion
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
ASTM	American Society for Testing and Materials
B&W	Babcock and Wilcox
DOD	Department of Defense
CE	Combustion Engineering
CERL	Construction Engineering Research Laboratory
EPRI	Electric Power Research Institute
FSI	Free Swelling Index
HGI	Hardgrove Grindability Index
PC	Pulverized Coal
TSG	Troubleshooting Guide
RFQ	Relative Free Quartz

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Appendix A: Overfeed Stoker-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality related problems that can be encountered in overfeed stoker-fired boiler systems. A general description of this system is included, but is limited to describing the major components (coal hopper, coal regulating gate, coal-ash bed grates, damper controls) that make up a complete overfeed stoker-fired system. For those interested, more detailed descriptions are provided in references 6, 7, 8.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

A1 System Description

A mechanical stoker is equipped with a mechanically operated coal feeding mechanism to feed coal into the boiler while simultaneously distributing it over the grate, admitting air to the coal for combustion, and removing ash. A specific type of mechanical stoker—the overfeed stoker—is one in which coal is admitted above the point of air admission to the coal bed.

There are three basic types of mechanical overfeed stokers: chain-grate stokers (Figure 1-1), traveling-grate stokers, and vibrating grate stokers (Figure 1-2). Fundamentally, chain- and traveling-grate stokers are similar except for grate construction. In the chain grate, the grate itself is a wide chain composed of links. In the traveling grate, the grate sections (bars or links) are attached to a separate chain. In either case the chain travels over two sprockets, one at the front and one at the rear of the furnace. These sprockets are equal in length to the width of the furnace. The front sprocket is connected to a variable-speed driving mechanism.

Chain- and traveling-grate stokers operate similarly. Coal is gravity fed onto the grate from a coal hopper mounted on the front of the stoker. The depth of coal fed on the grate is regulated by raising and lowering a sliding coal gate at the hopper coal discharge (Figure 1-1). The coal burns as the grate travels from one end of the furnace to the other. The ash is continuously deposited off the rear of the grate into an ash pit.

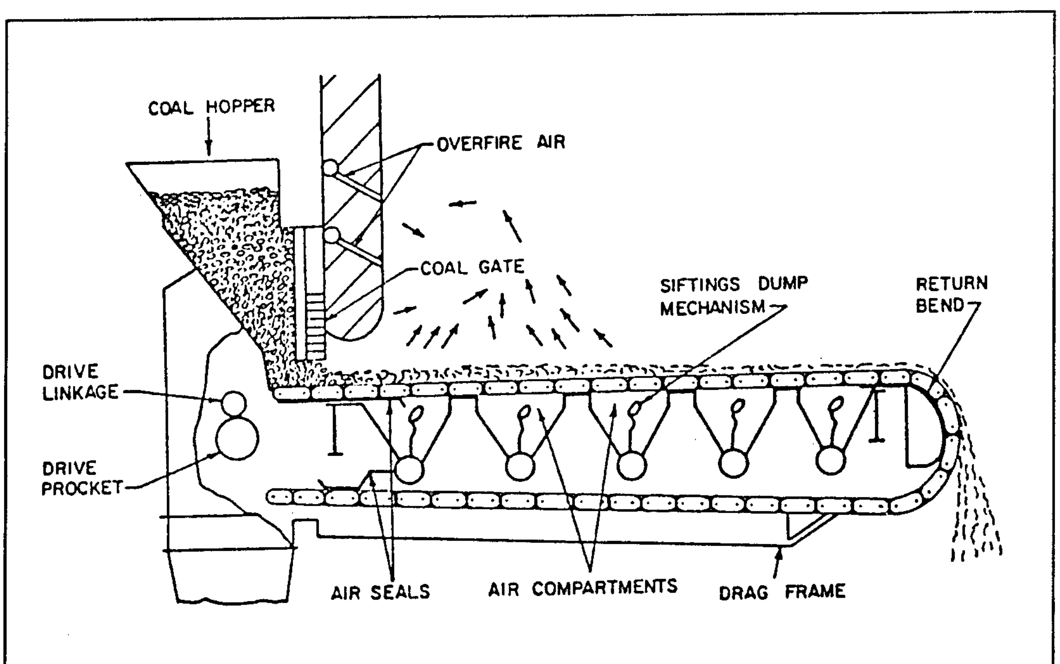


Figure 1-1. Chain grate stoker.

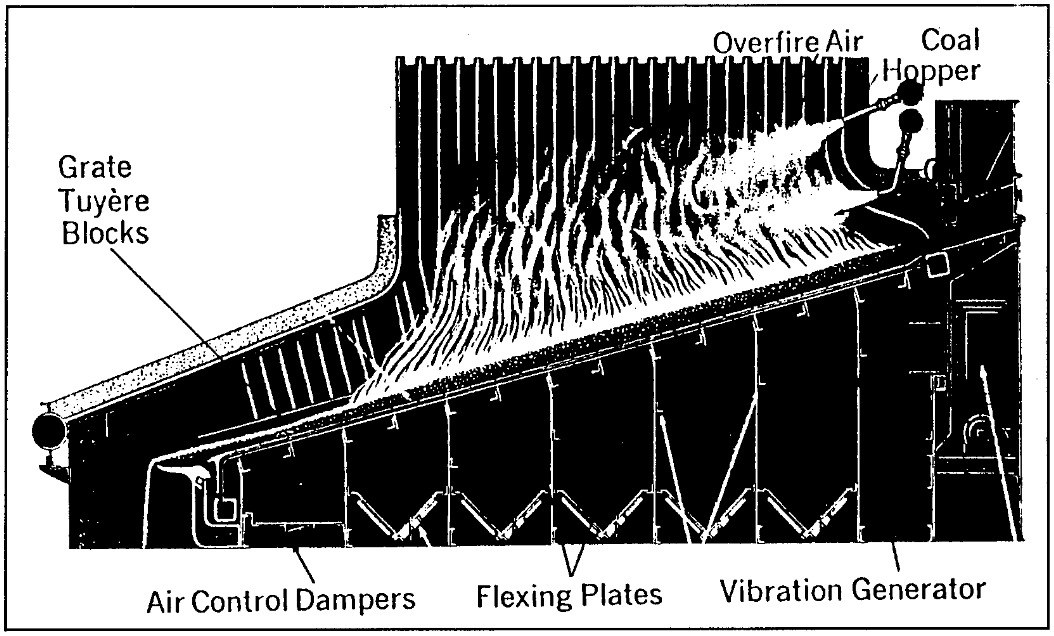


Figure 1-2. Vibrating grate stoker.

Air for combustion enters through openings in the grate (undergrate air) and through overfire air jets. Undergrate air is manually controlled through individual air zones or compartments underneath the grate. Air from overfire air jets enters the furnace through the front arch—roofs over parts of the furnace used to direct the flame and to protect parts of the boiler from direct heat—or the front wall above the arch. Over-fire air and undergrate air that passes through the fuel bed, provide turbulence (mixing of combustible gases) for rapid combustion. Overfire air jets can also be located at the rear wall to provide a counterflow of gases in the furnace, promoting increased turbulence and further reducing smoke emissions.

Vibrating grate stokers (Figure 1-2) operate similarly to chain- and traveling-grate stokers. However, the vibrating stoker uses vibration and gravity to move the coal-ash bed from coal feed to ash discharge. Coal that is gravity fed from a coal hopper onto the grate passes underneath a gate that controls the thickness of the coal bed on the grate. The grate is vibrated by a vibration generator that consists of two unbalanced weights rotating in opposite directions to impact the desired vibration to the grates. The vibration and inclination of the grate causes the coal bed to move through the furnace toward the ash pit.

Flexible plates divide the space beneath the combustion grate into compartments. Individual supply ducts with dampers regulate air distributing through the coal-ash bed. Overfire air jets on the front wall promote mixing of volatile gases and air for more complete combustion.

A2 Block Flow Diagram

The overfeed stoker-fired boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality), sequentially arranged to show:

- coal flow through the coal handling equipment
- flue gas flow through the boiler/components, flyash recycle and flue gas cleanup (FGC) subsystem, the induced draft fan and chimney/stack
- ash discharge to the ash hopper/pit.

These specific components are identified in Figure 1-3. The first six components have been grouped collectively under a category entitled coal-handling equipment. Coal-handling equipment includes all components that process the coal from its delivery on site to the coal regulating gate. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- coal feeders that transport coal to the stoker coal hopper
- coal regulating gates that serve to control coal flow rate and coal bed depth on the grates.

The next four components have been loosely grouped under the category entitled Boiler/components. Again, it includes equipment that, depending on plant design, may include:

- forced draft fan
- grates (specifically chain grates, traveling grates and vibrating grates)
- refractory surfaces
- heat transfer surfaces - boiler tubes, water walls and baffles.

The next two blocks represent the flyash recycle and particulate removal subsystems. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

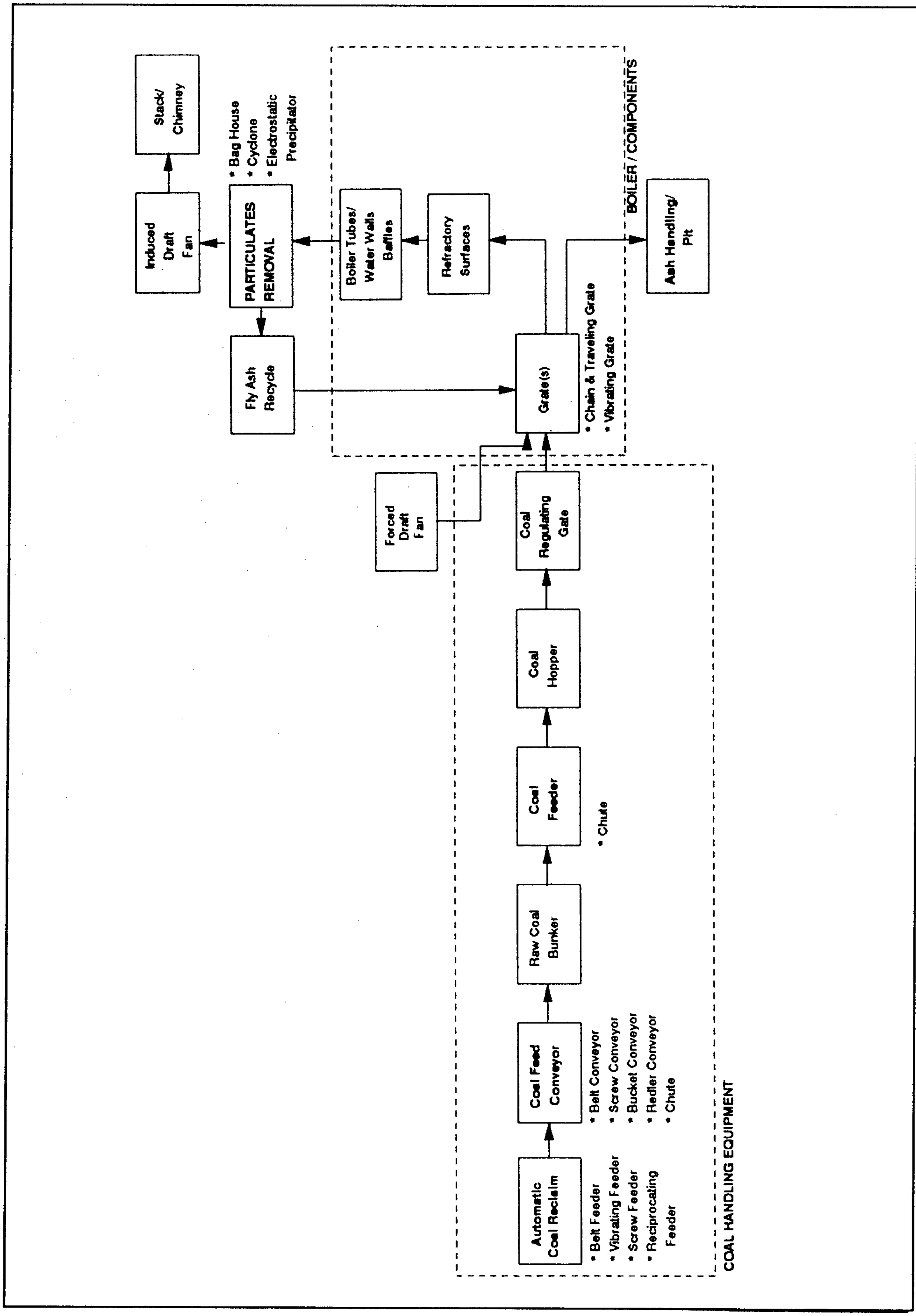


Figure 1-3. Overfeed stoker-fired boiler system components block flow diagram.

The next subsystem identified in the block flow diagram is the fan subsystem. Overfeed stoker-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the Guide include:

- forced draft (FD) fans, which supply undergrate air
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality. The final subsystems addressed in the Guide include those components equipped to handle ash. Specific components include the chimney/stack and the ash hopper/pit.

A3 Troubleshooting Logic

The component/symptom Guide table (Figure 1-4) serves to identify:

- Typical symptoms (problems) that may be encountered in underfeed stoker-fired boiler systems. These symptoms are arranged horizontally along the top of the table
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram
- The logic diagrams.

The remainder of this Appendix consists of 92 logic diagrams, arranged by component and by all the symptoms that can affect that component.

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																				
Automatic Coal Reclaim																				
1) Belt Feeder	● 1-5	● 1-6	● 1-7	● 1-8																
2) Vibrating Feeder	● 1-9	● 1-10	● 1-11	● 1-12																
3) Screw Feeder	● 1-13	● 1-14	● 1-15	● 1-16																
4) Reciprocating Feeder	● 1-17	● 1-18	● 1-19	● 1-20																
Coal Feed Conveyor																				
1) Belt Conveyor	● 1-21	● 1-22	● 1-23	● 1-24																
2) Screw Conveyor	● 1-25	● 1-26	● 1-27	● 1-28																
3) Bucket Conveyor	● 1-29	● 1-30	● 1-31	● 1-32																
4) Redler Conveyor	● 1-33	● 1-34	● 1-35	● 1-36																
5) Chute		● 1-37	● 1-38	● 1-39																

Figure 1-4. Overfeed stoker—component/symptom guide (part 1).

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIP.(CONT'D)																				
Coal Feeders																				
Chute		● 1-40	● 1-41	● 1-42																
Coal Bunker		● 1-43	● 1-44	● 1-45																
Coal Hopper		● 1-46	● 1-47	● 1-48																
Coal Regulating Gate	● 1-49	● 1-50	● 1-51	● 1-52																
BOILER / COMPONENTS																				
Boiler			● 1-53											● 1-54						
1) Grates (Chain & Traveling or Vibrating grate)					● 1-55	● 1-56	● 1-57	● 1-58	● 1-59	● 1-60	● 1-61	● 1-62	● 1-63							
2) Refractory Surfaces					● 1-64											● 1-65	● 1-66			
3) Boiler Tubes/Water Walls					● 1-67											● 1-68	● 1-69	● 1-70		
4) Baffles					● 1-71											● 1-72	● 1-73	● 1-74		

Figure 1-4. Overfeed stoker—component/symptom guide (part 2).

COMPONENT \ SYMPTOM	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS				
FANS																								
1) Forced Draft			● 1-75												● 1-76									
2) Induced Draft			● 1-77		● 1-78										● 1-79	● 1-80								
PARTICULATE REMOVAL																								
1) Baghouse													● 1-81						● 1-82					
2) Cyclone													● 1-83			● 1-84			● 1-85					
3) Electrostatic Precipitator													● 1-86			● 1-87			● 1-88					
ASH HANDLING																								
1) Fly Ash Recycle													● 1-89											
2) Ash Hopper/Pit												● 1-90	● 1-91											
Stack/Chimney					● 1-92								● 1-93		● 1-94				● 1-95	● 1-96				

Figure 1-4. Overfeed stoker—component/symptom guide (part 3).

FIGURE 1-5: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim (Belt Feeder)

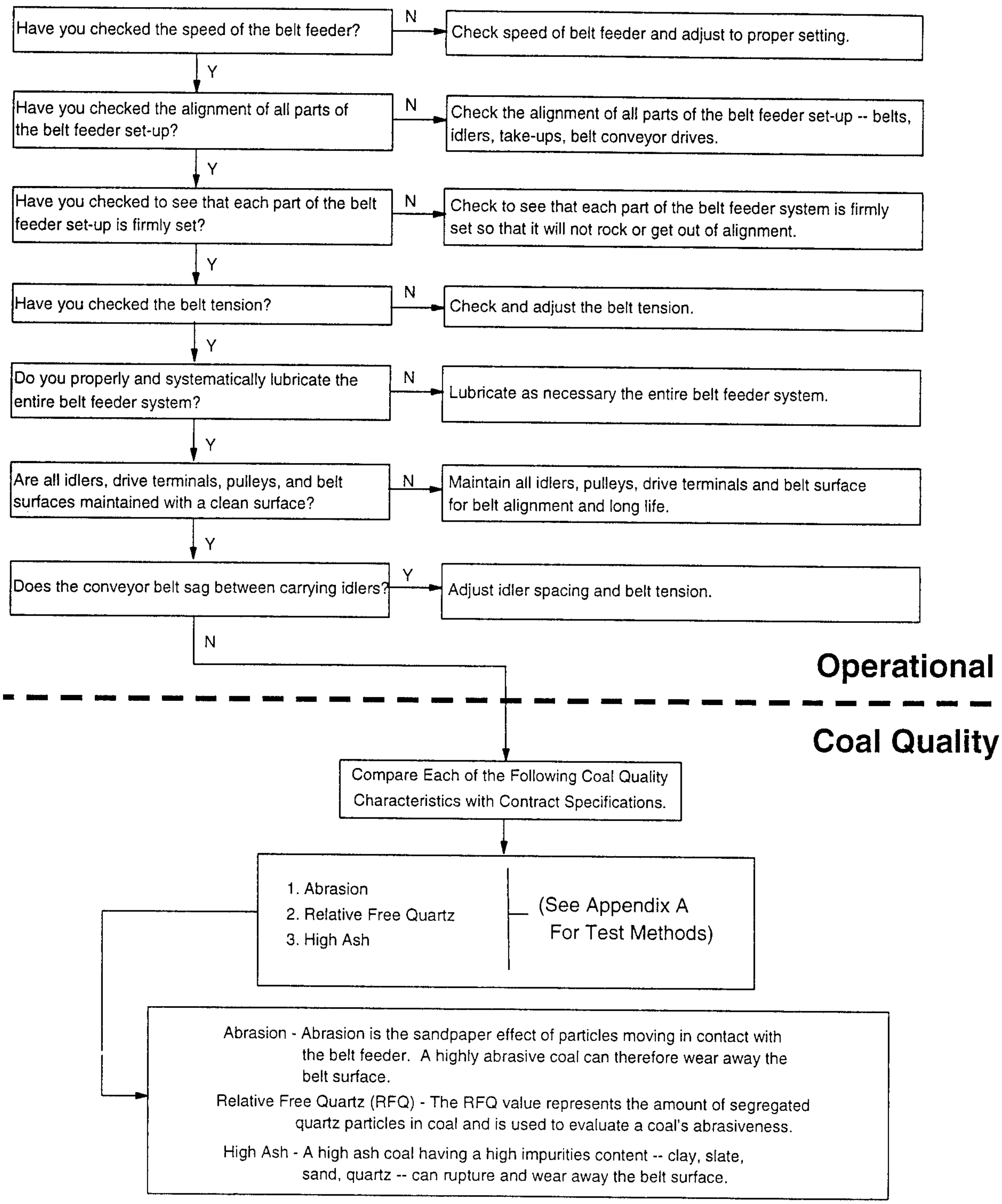


Fig 1-5n/1

FIGURE 1-6: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Belt Feeder)

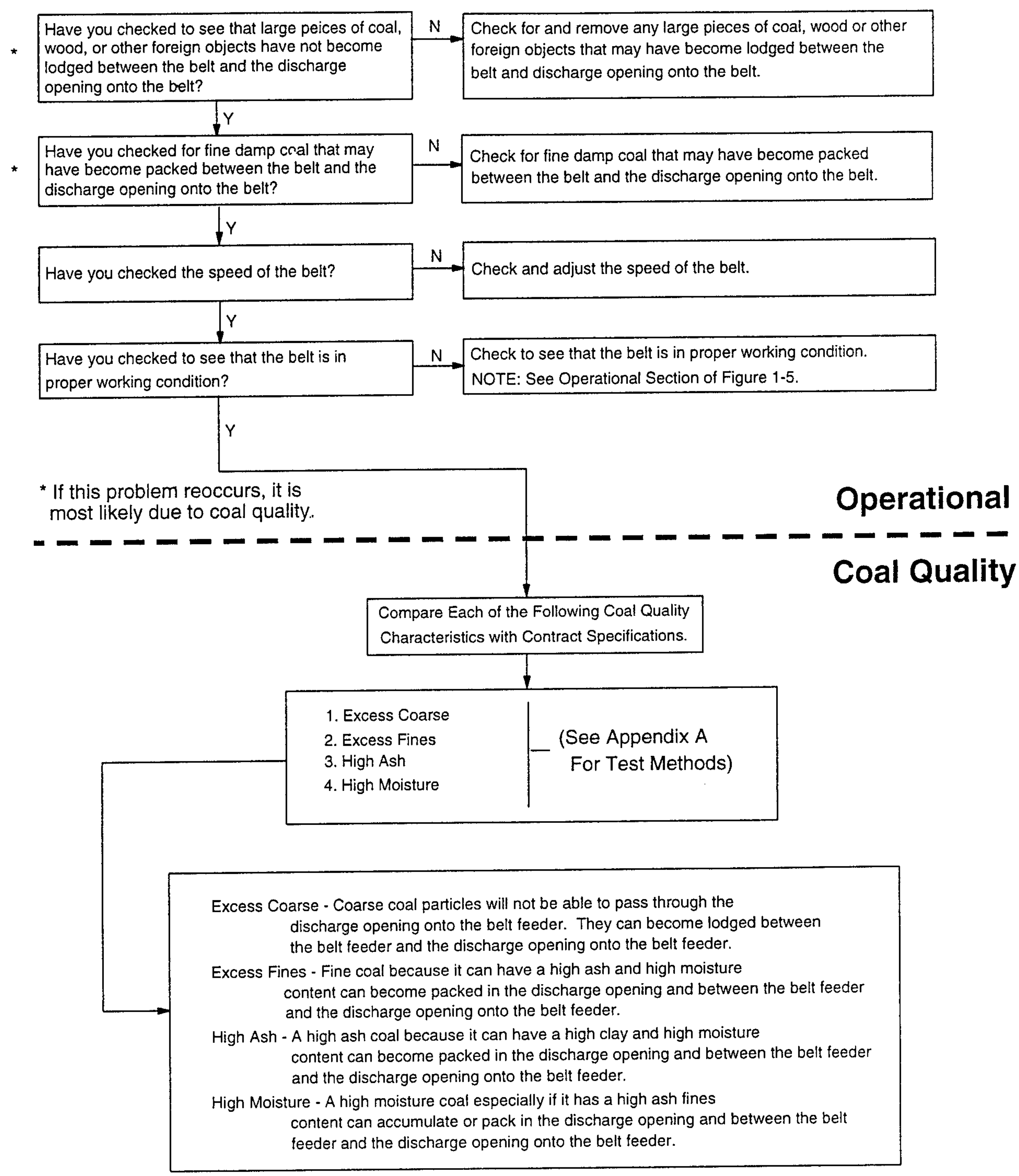


FIG1-6n/1

FIGURE 1-7: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Belt Feeder)

Have you checked to see that coal is not spilling over the sides of the belt?
N → Check to see that coal is not spilling over the sides of the belt.
Y ↓

* Have you checked to see that fine moist coal is not sticking to the belt?
N → Check for fine moist coal sticking to the belt.
Y ↓

Have you checked to see that the belt is in good condition?
N → Check working condition of the belt. NOTE: See Operational Section of Figure 1-5.
Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG1-7n/1

FIGURE 1-8: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim (Belt Feeder)

* Have you checked to see that fine damp coal is not sticking to the belt?
N → Check to see that fine damp coal is not sticking to the belt.
Y ↓

Have you checked to see that coal is not spilling over the sides of the belt?
N → Check to see that coal is not spilling over the sides of the belt.
Y ↓

Have you checked the condition of the belt and the conveyor belt system?
N → Check the working condition of the belt. NOTE: See Operational Section of Figure 1-5.
Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG1-8n/1

FIGURE 1-9: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Vibrating Feeder)

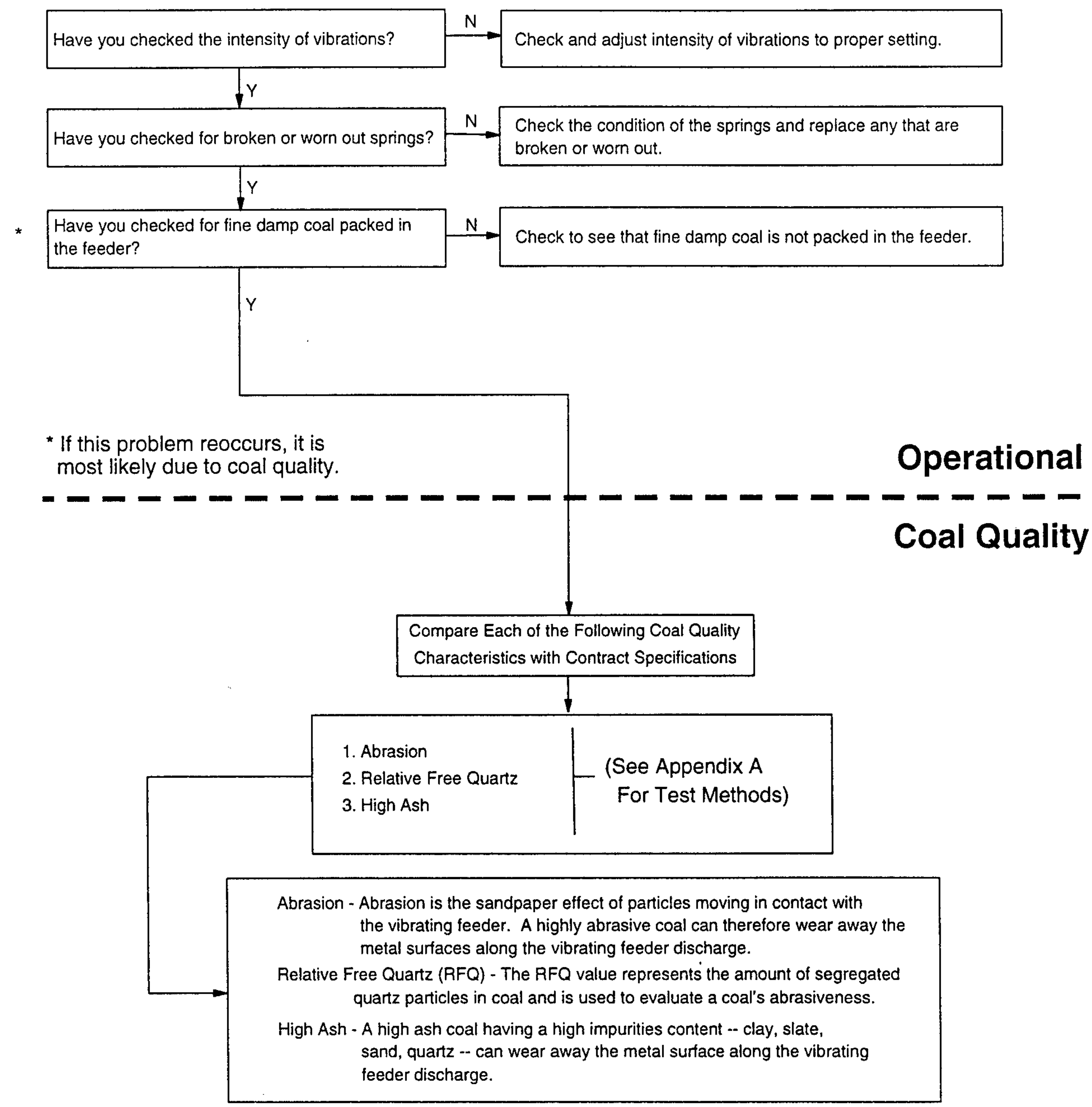


FIG1-9n/1

FIGURE 1-10: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim (Vibrating Feeder)

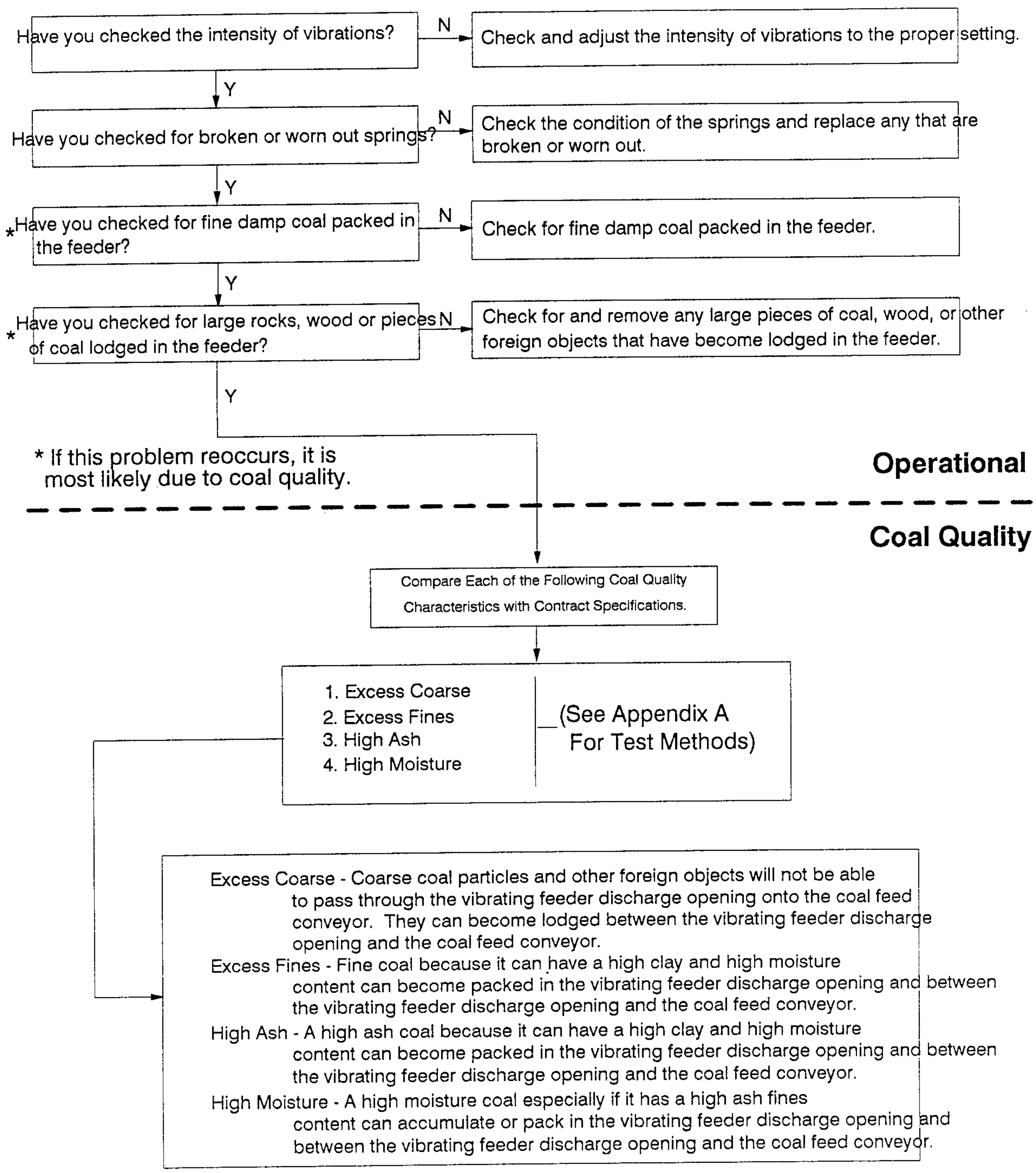


FIG1-10n/1

FIGURE 1-11: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Vibrating Feeder)

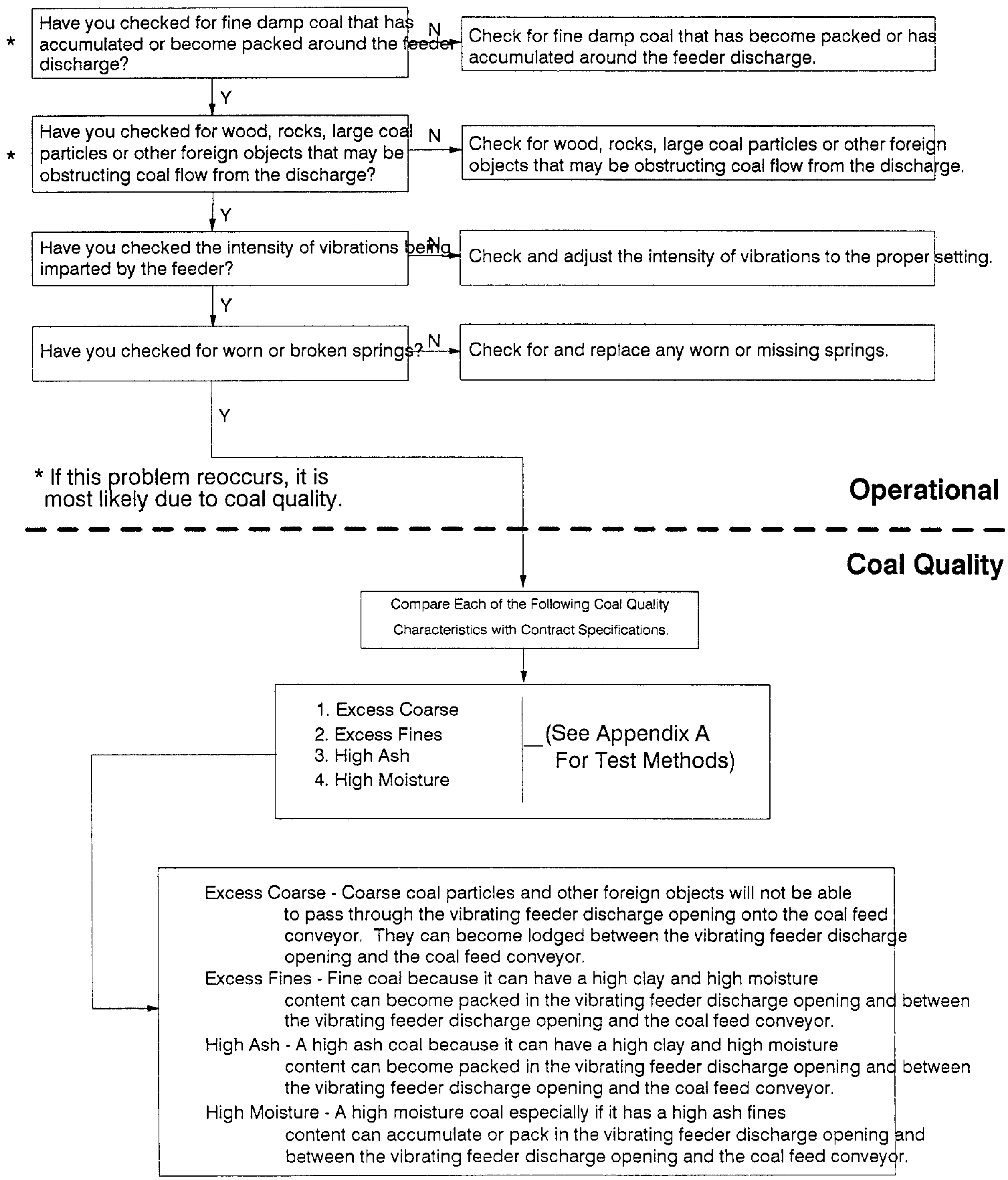


FIG1-11n/1

FIGURE 1-12: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim (Vibrating Feeder)

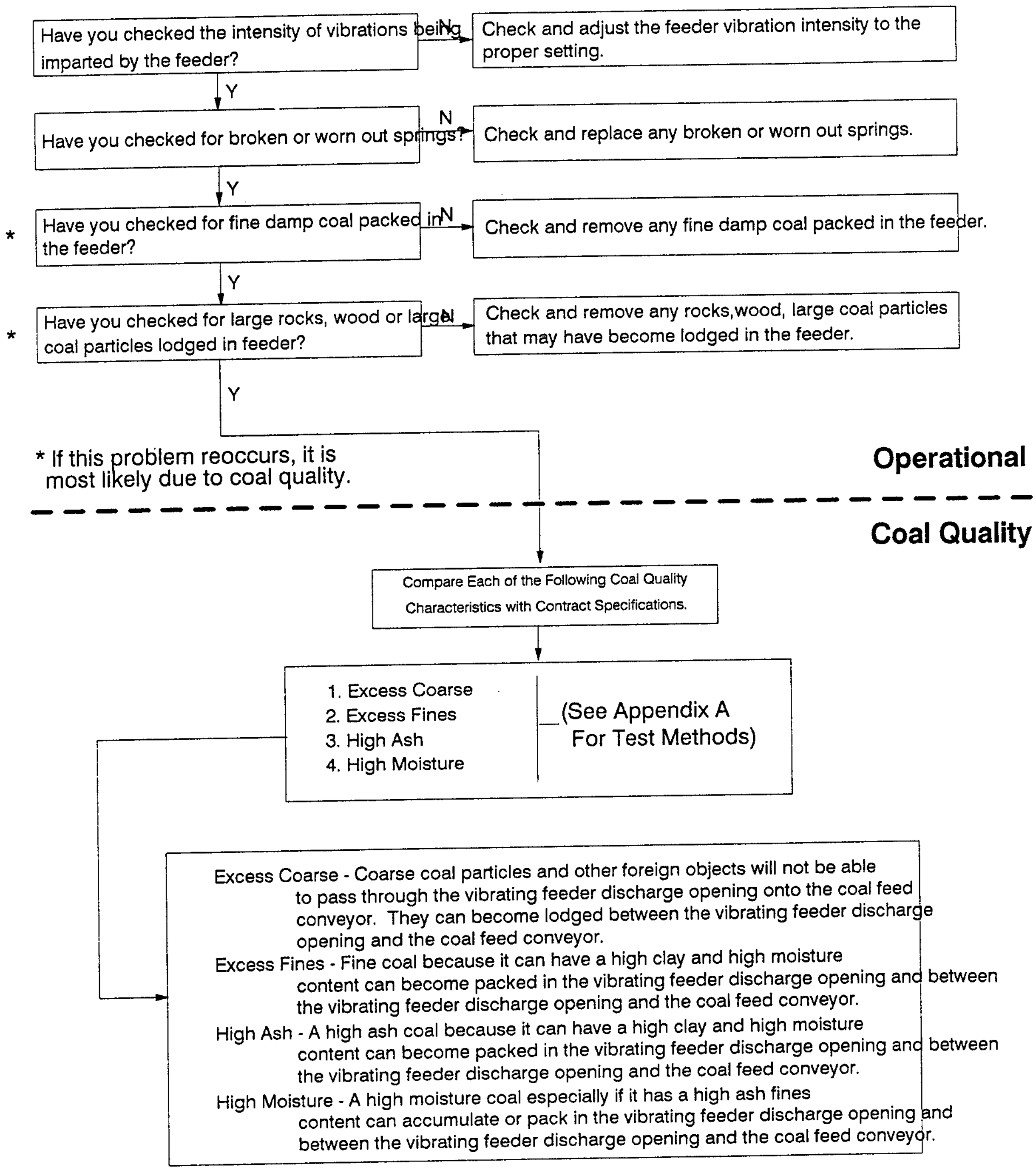


FIG1-12n/1

FIGURE 1-13: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Screw Feeder)

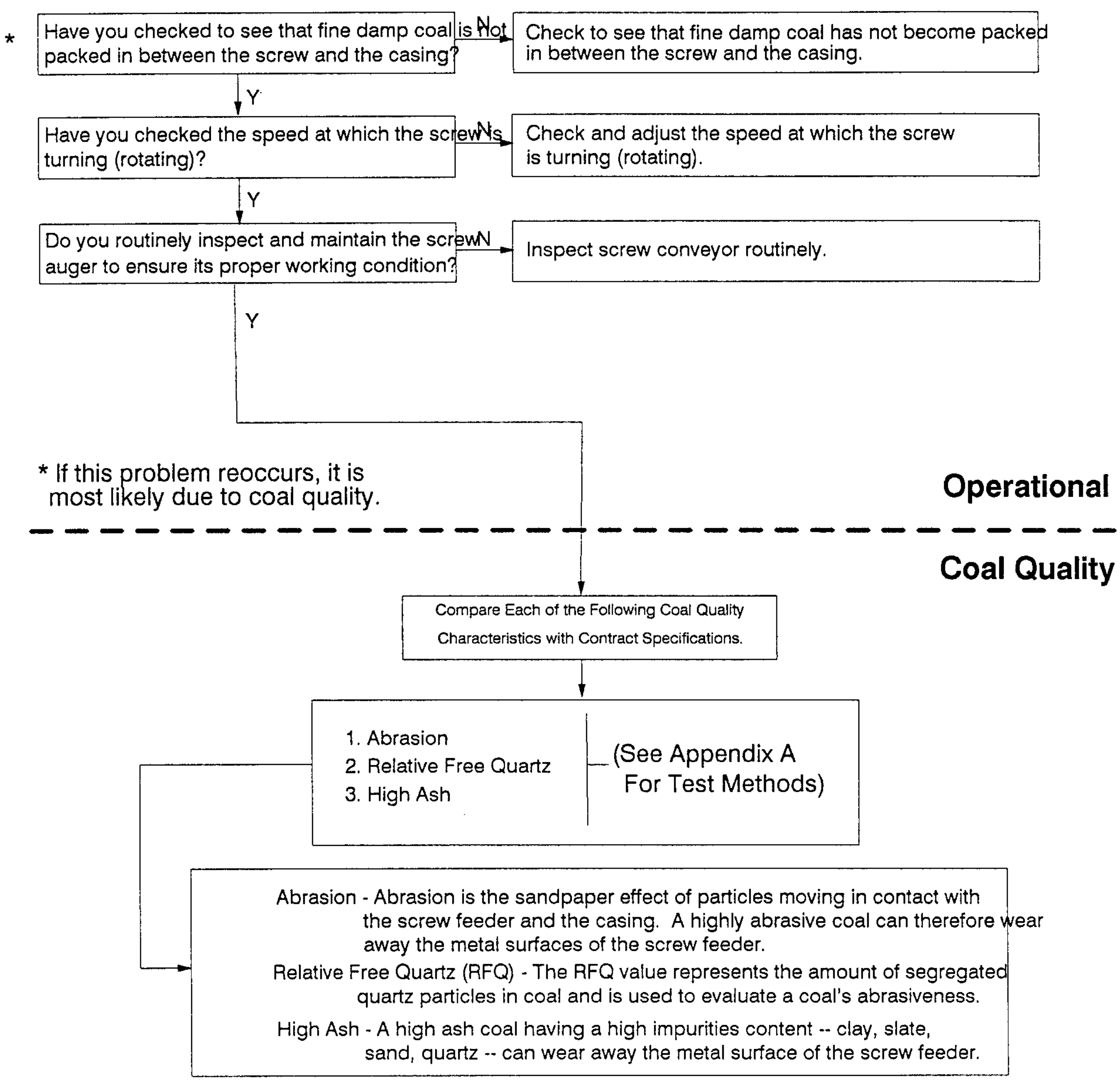


FIG1-13n/1

FIGURE 1-14: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim (Screw Feeder)

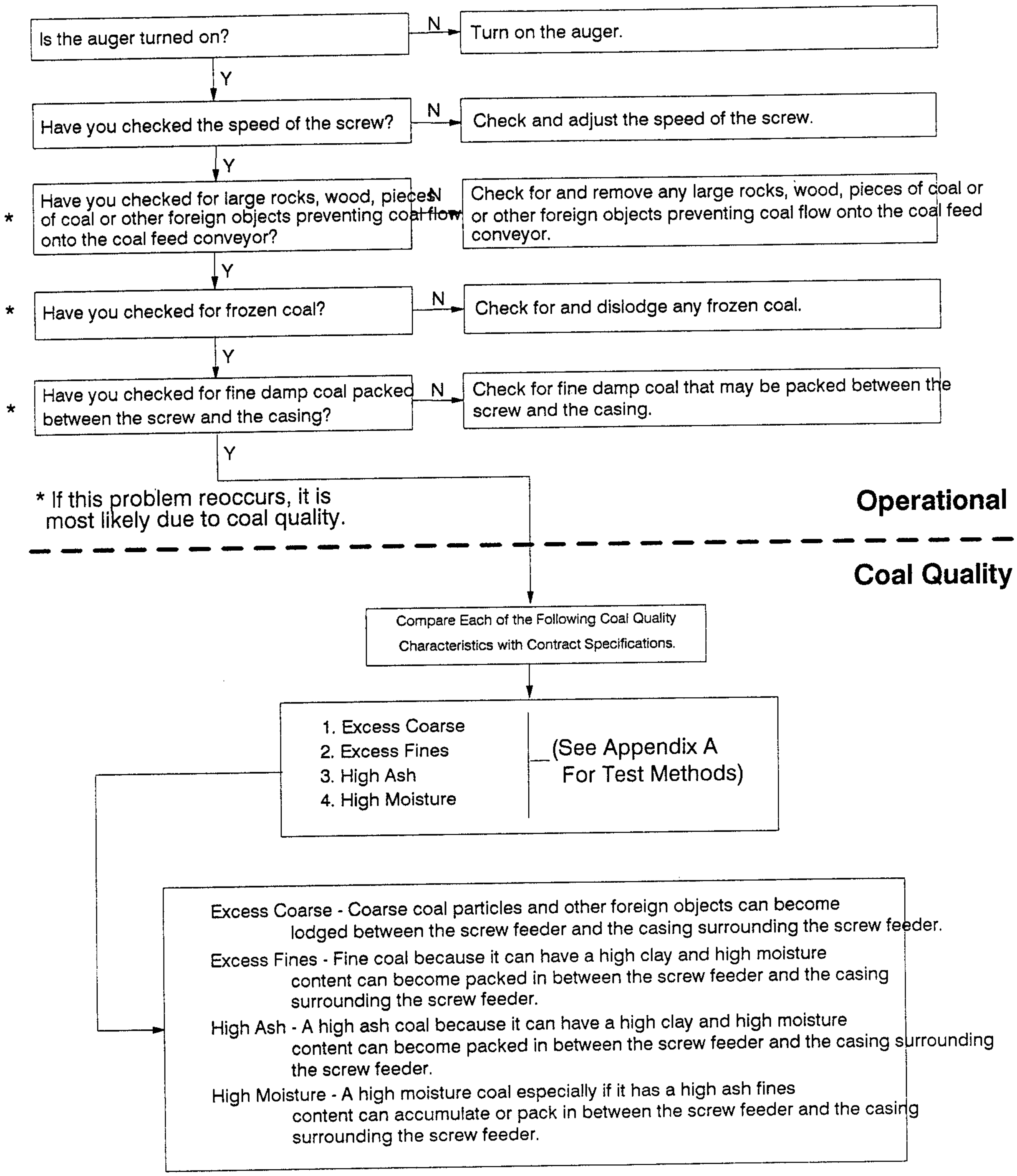


FIG1-14n/1

FIGURE 1-15: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Screw Feeder)

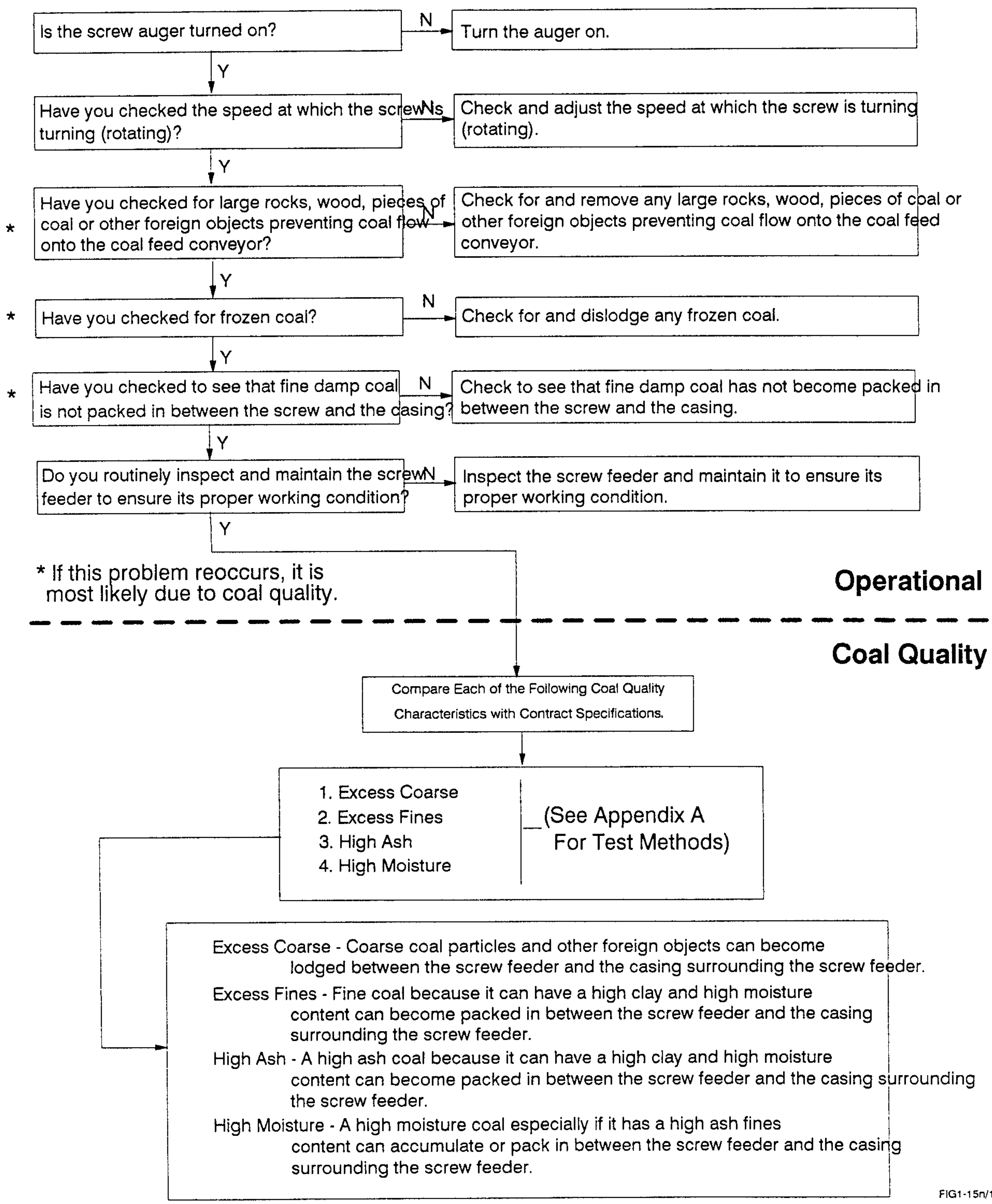


FIG1-15n/1

FIGURE 1-16: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feed From The Automatic Coal Reclaim
(Screw Feeder)

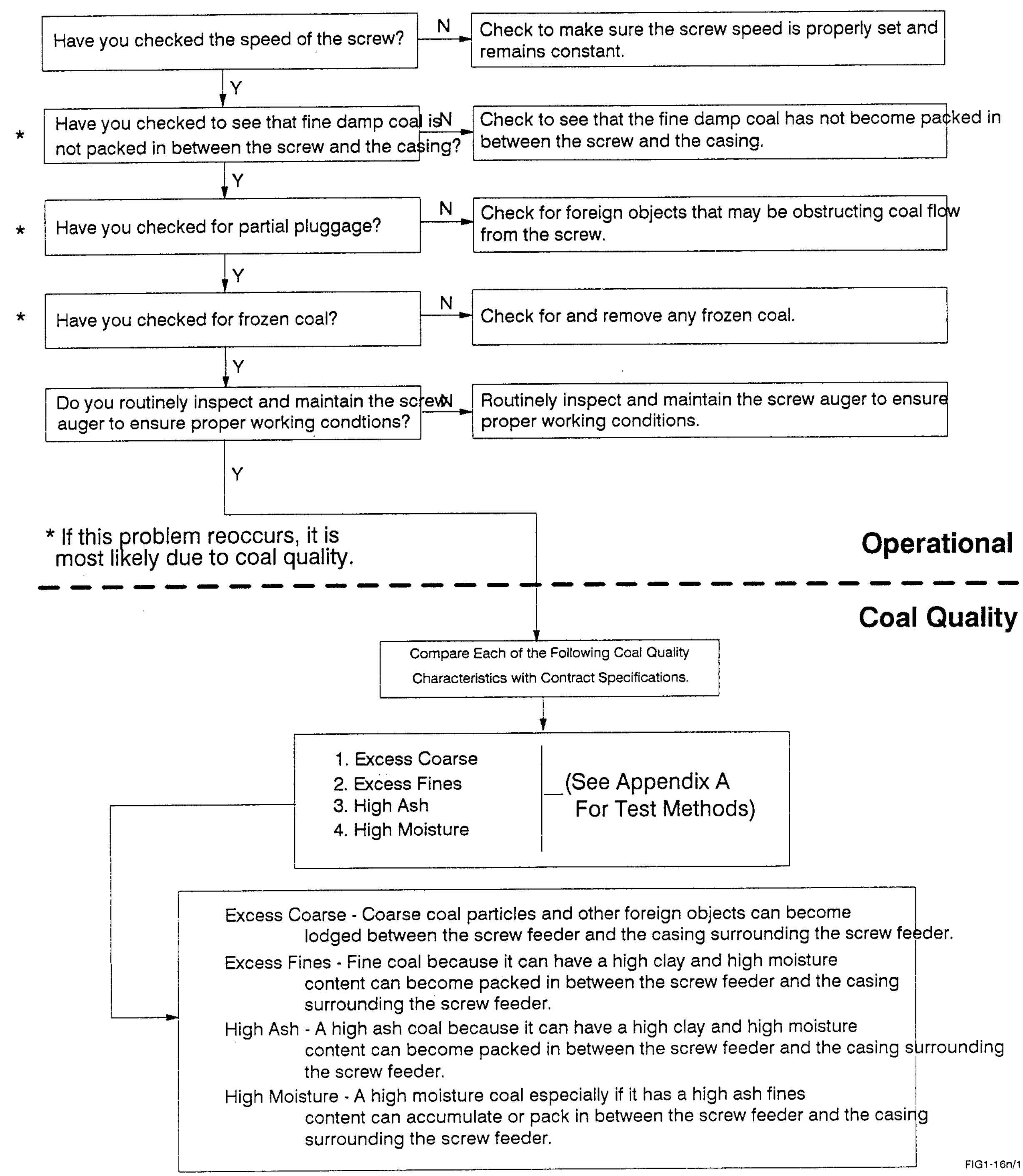


FIG1-16n/1

FIGURE 1-17: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Reciprocating Feeder)

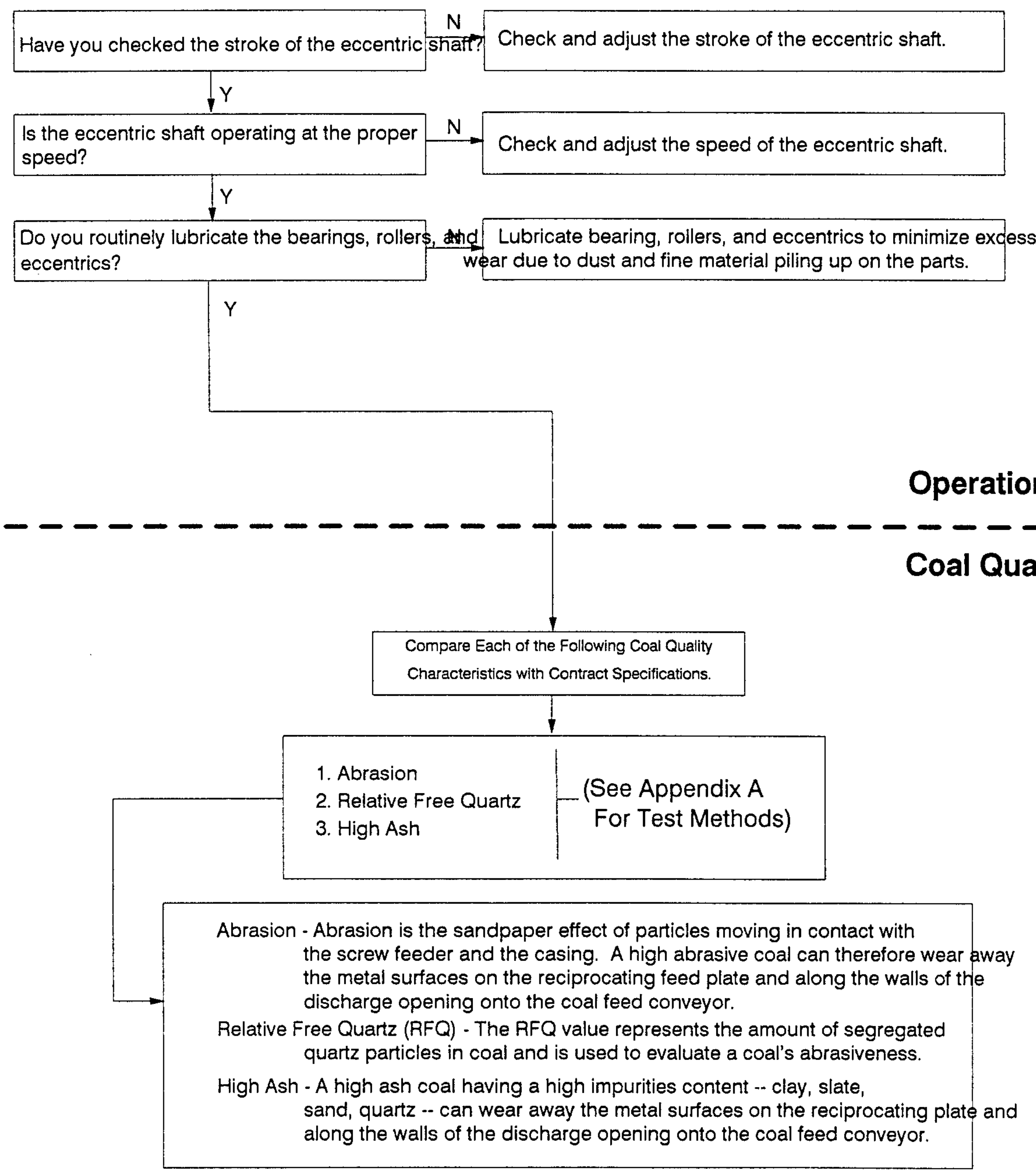


FIG1-17n/1

FIGURE 1-18: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Reciprocating Feeder)

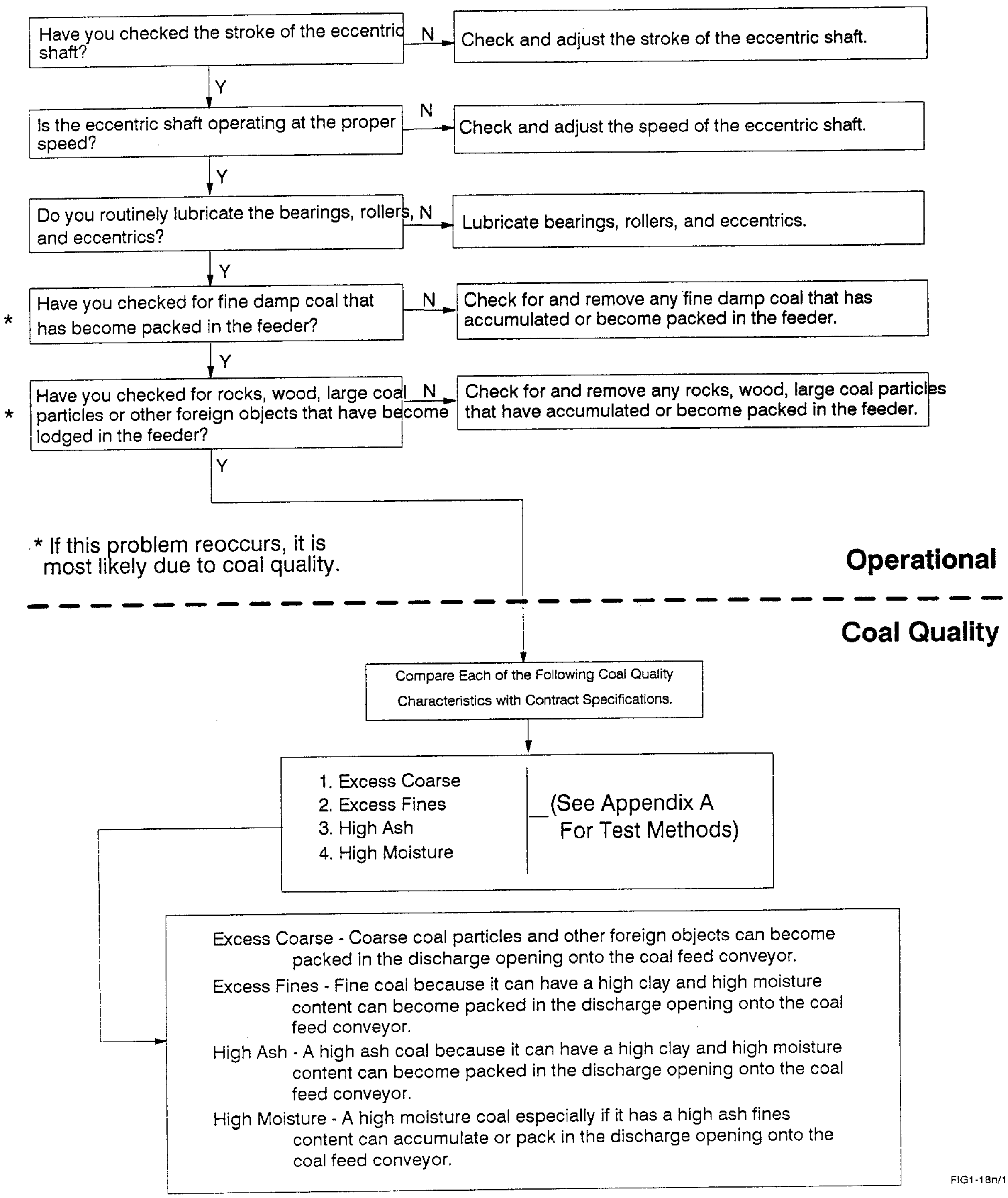


FIG1-18n/1

FIGURE 1-19: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Reciprocating Feeder)

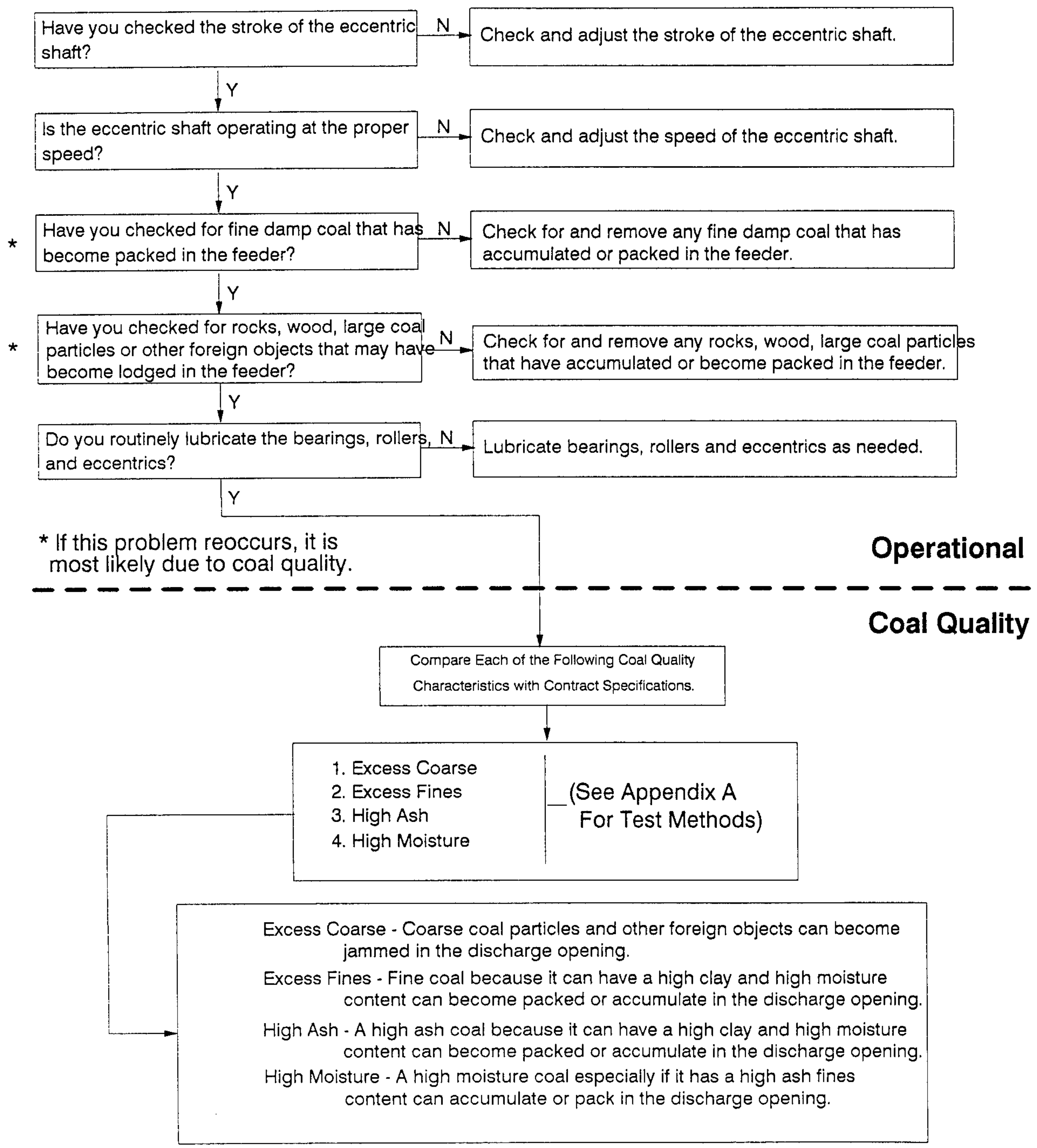


FIG1-19n/1

FIGURE 1-20: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Reciprocating Feeder)

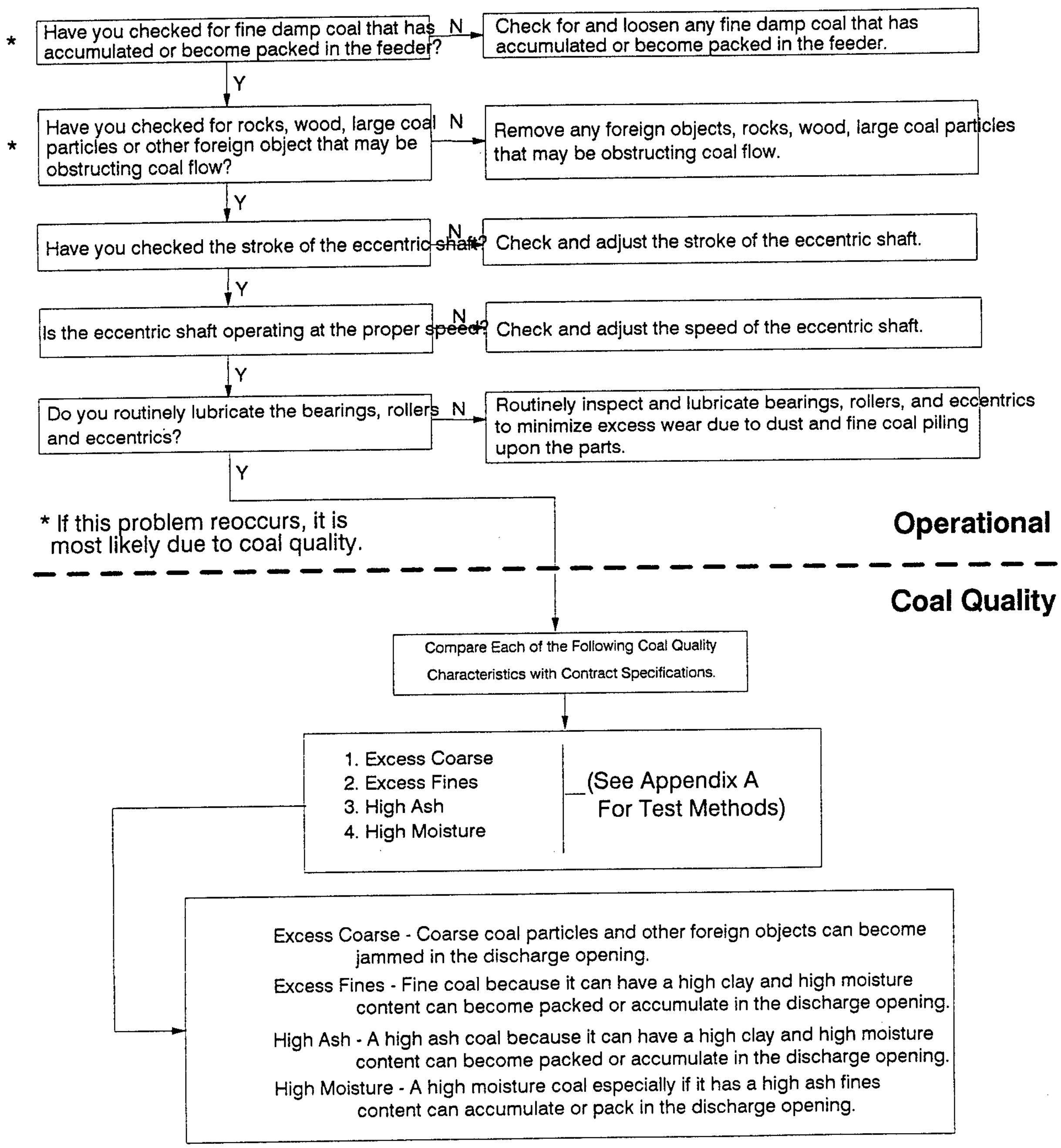


FIG1-20n/1

FIGURE 1-21: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Feed Conveyor

(Belt Conveyor)

Have you checked the alignment of all parts of the conveyor setup?	N	Check the alignment of all parts of the conveyor set-up -- conveyor belt, idlers, take ups, belt conveyor drives.
Have you checked to see that each part of the conveyor set-up is firmly set?	N	Check to see that each part of the conveyor system is firmly set so that it will not rock or get out of alignment.
Have you checked the belt tension?	N	Check and adjust the belt tension.
Do you properly and systematically lubricate the entire conveyor belt system?	N	Lubricate as necessary the entire conveyor belt system.
Have you checked for frozen belt idlers?	N	Check for frozen belt idlers.
Are all idlers, drive terminals and pulleys, and belt surface maintained with a clean surface?	N	Maintain all idlers, pulleys, drive terminals, and the belt surface with a clean surface for belt alignment and long life.
Does the conveyor belt sag between carrying idlers?	Y	Adjust idler spacing and belt tension.
Have you checked the belt speed?	N	Check belt speed and adjust to proper setting.

(Each question leads to the next on Y; "Does the conveyor belt sag between carrying idlers?" leads to the next on N; "Have you checked the belt speed?" — Y → Compare Each of the Following Coal Quality Characteristics with Contract Specifications.)

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion - Abrasion is the sandpaper effect of particles moving in contact with the belt conveyor. A highly abrasive coal can therefore wear away the belt surface.

Relative Free Quartz (RFQ) - The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash - A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can rupture and wear away the belt surface.

FIG1-21n/1

FIGURE 1-22: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Feed Conveyor
(Belt Conveyor)

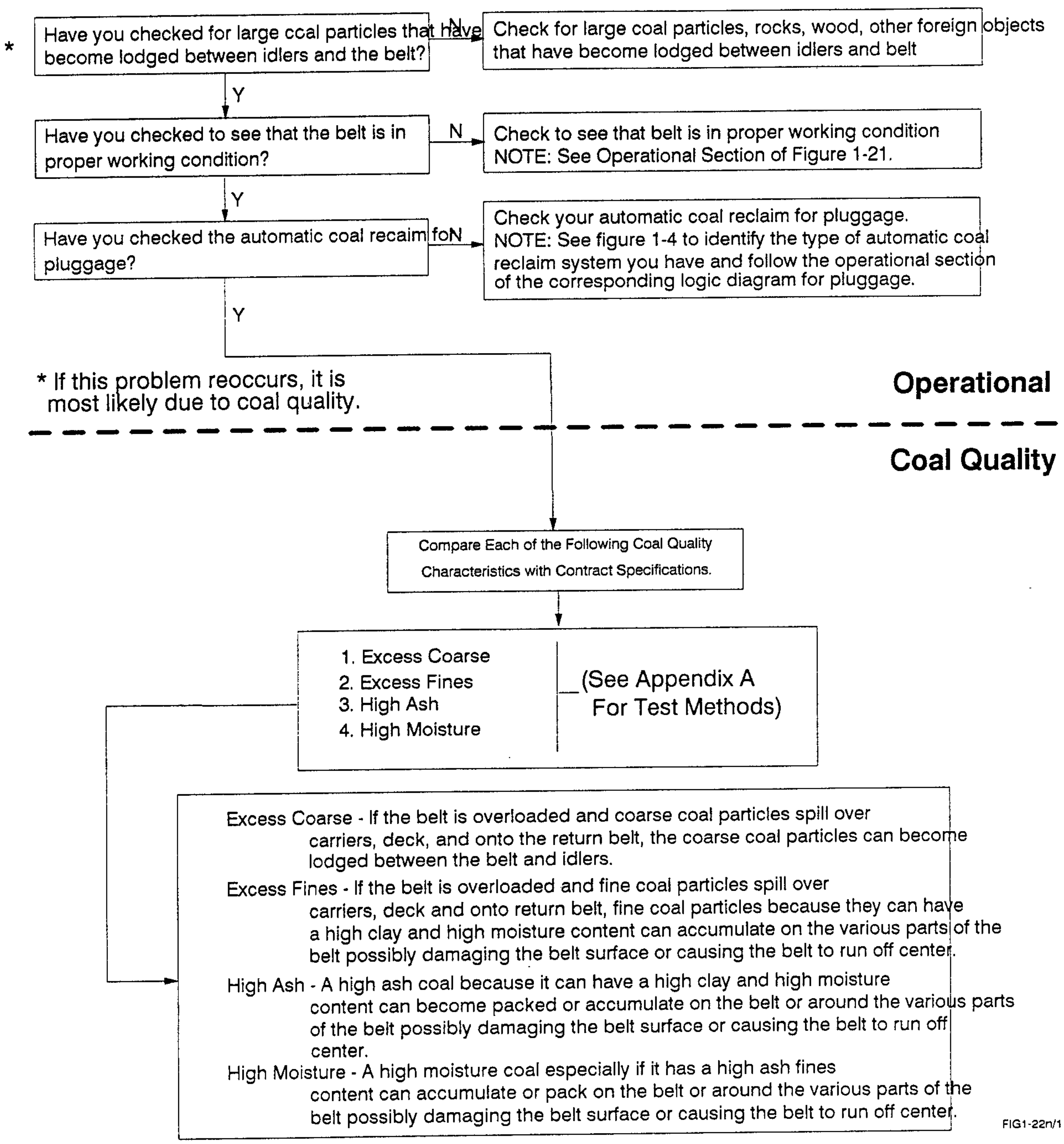


FIGURE 1-23: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Belt Conveyor)

Have you checked to see that coal is not spilling over the sides of the belt? — N → Check for coal spilling over the sides of the belt.

Y

* Have you checked to see that fine moist coal is not sticking to the belt? — N → Check for moist fine coal sticking to the belt.

Y

Have you checked to see that the belt is in good working condition? — N → Checking the working condition of the belt. NOTE: See Operational Section Of Figure 1-21.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - If the belt is overloaded and coarse coal particles spill over carriers, deck, and onto the return belt, the coarse coal particles can become lodged between the belt and idlers.

Excess Fines - If the belt is overloaded and fine coal particles spill over carriers, deck and onto return belt, fine coal particles because they can have a high clay and high moisture content can accumulate on the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

FIG1-23n/1

FIGURE 1-24: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Belt Conveyor)

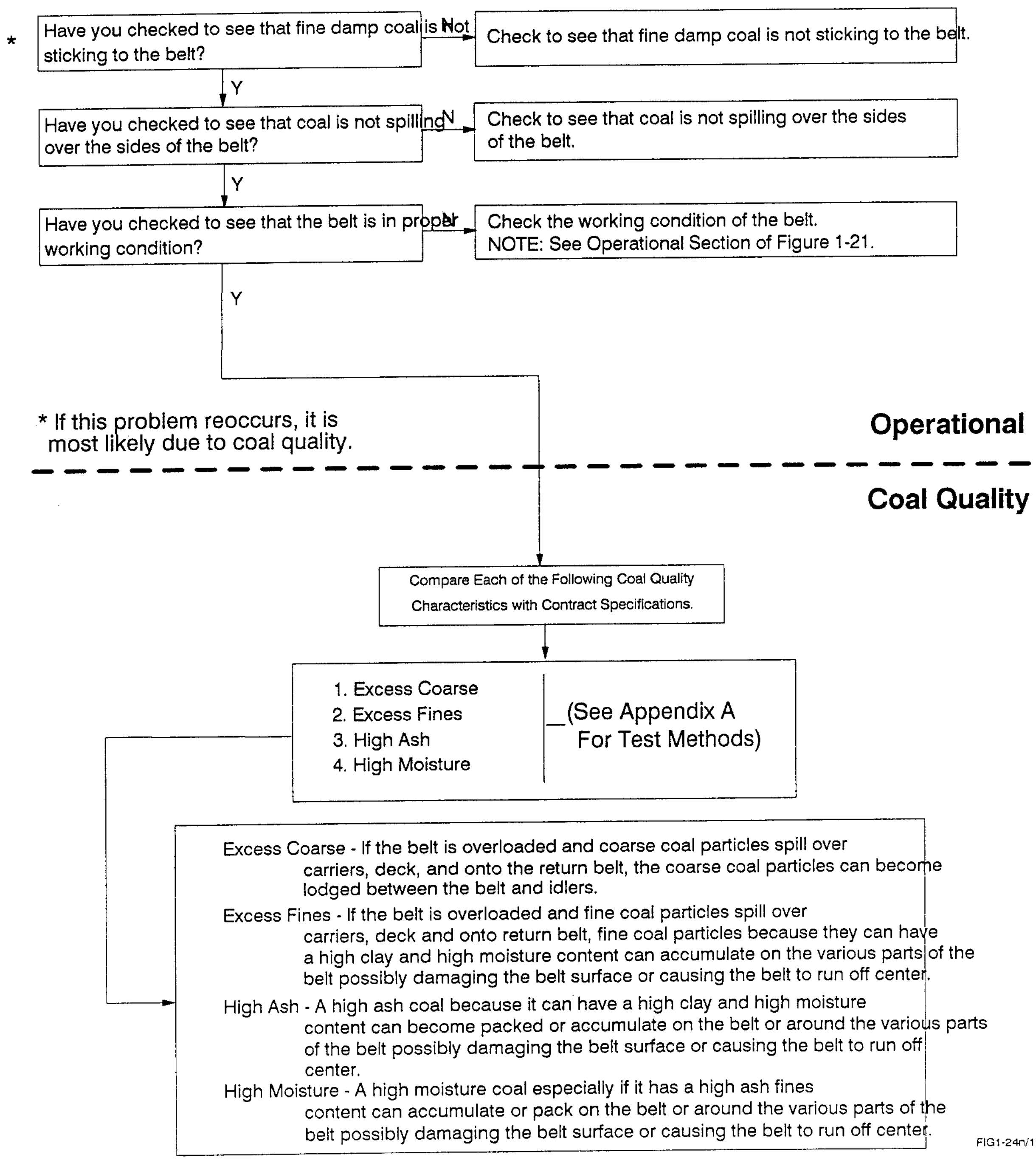


FIG1-24n/1

FIGURE 1-25: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM for Excess Wear In The Coal Feed Conveyor (Screw Conveyor)

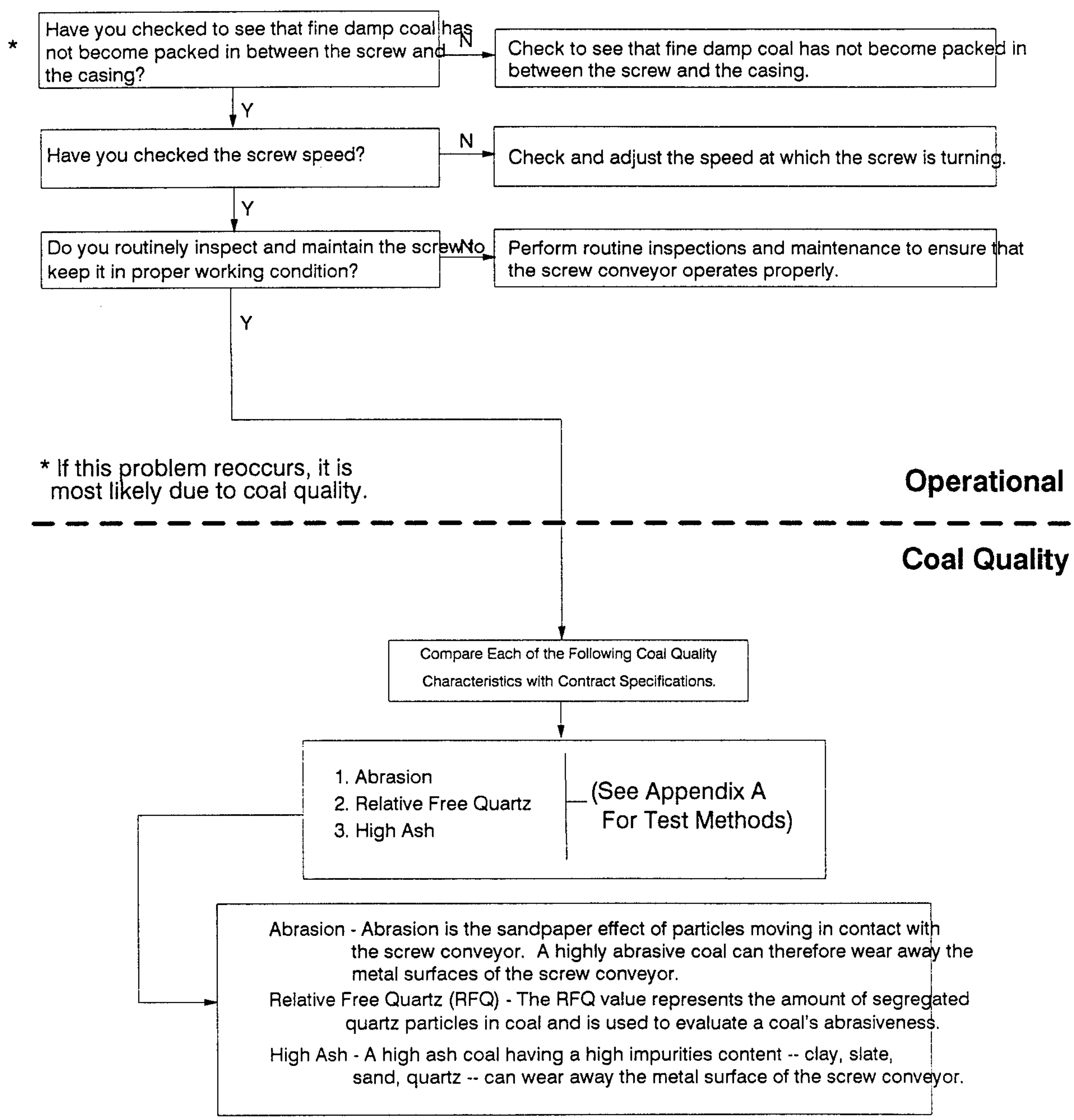


FIG1-25n/1

FIGURE 1-26: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Screw Conveyor)

* Have you checked for large rocks, wood, pieces of coal or other foreign objects that may be preventing flow of coal?
- N → Check for and remove any large rocks, wood, pieces of coal or other foreign objects preventing coal flow.
- Y ↓

Have you checked the speed of the screw?
- N → Check and adjust speed of the screw.
- Y ↓

* Have you checked for frozen coal?
- N → Check and dislodge any frozen coal.
- Y ↓

Have you checked for pluggage in your automatic coal reclaim?
- N → Inspect your automatic coal reclaim system for pluggage. NOTE: See Figure 1-4 to identify the type of automatic coal reclaim system you have and follow the operational section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw conveyor and the casing surrounding it.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw conveyor and the casing surrounding it.

FIG1-26n/1

FIGURE 1-27: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Screw Conveyor)

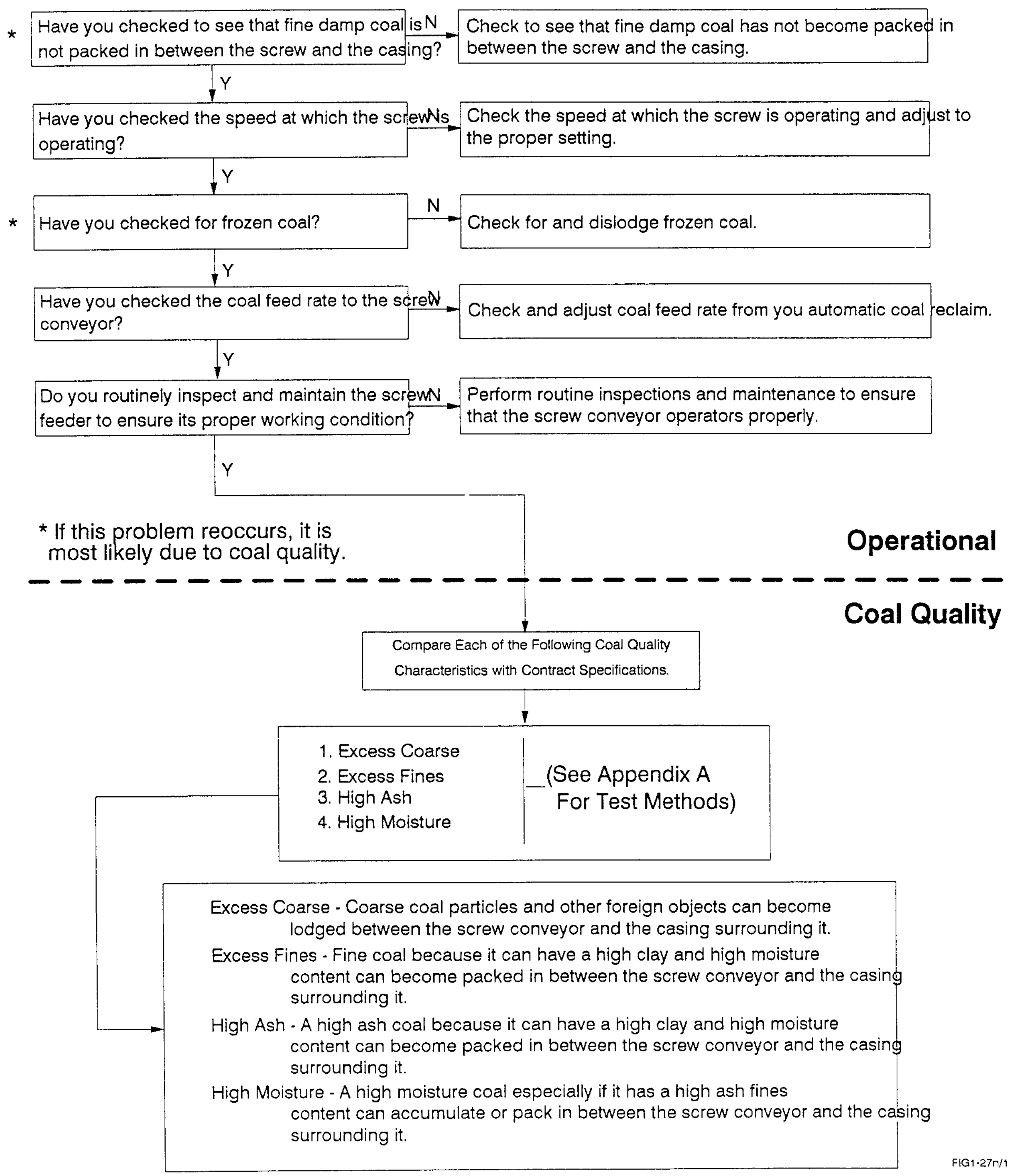


FIGURE 1-28: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor
(Screw Conveyor)

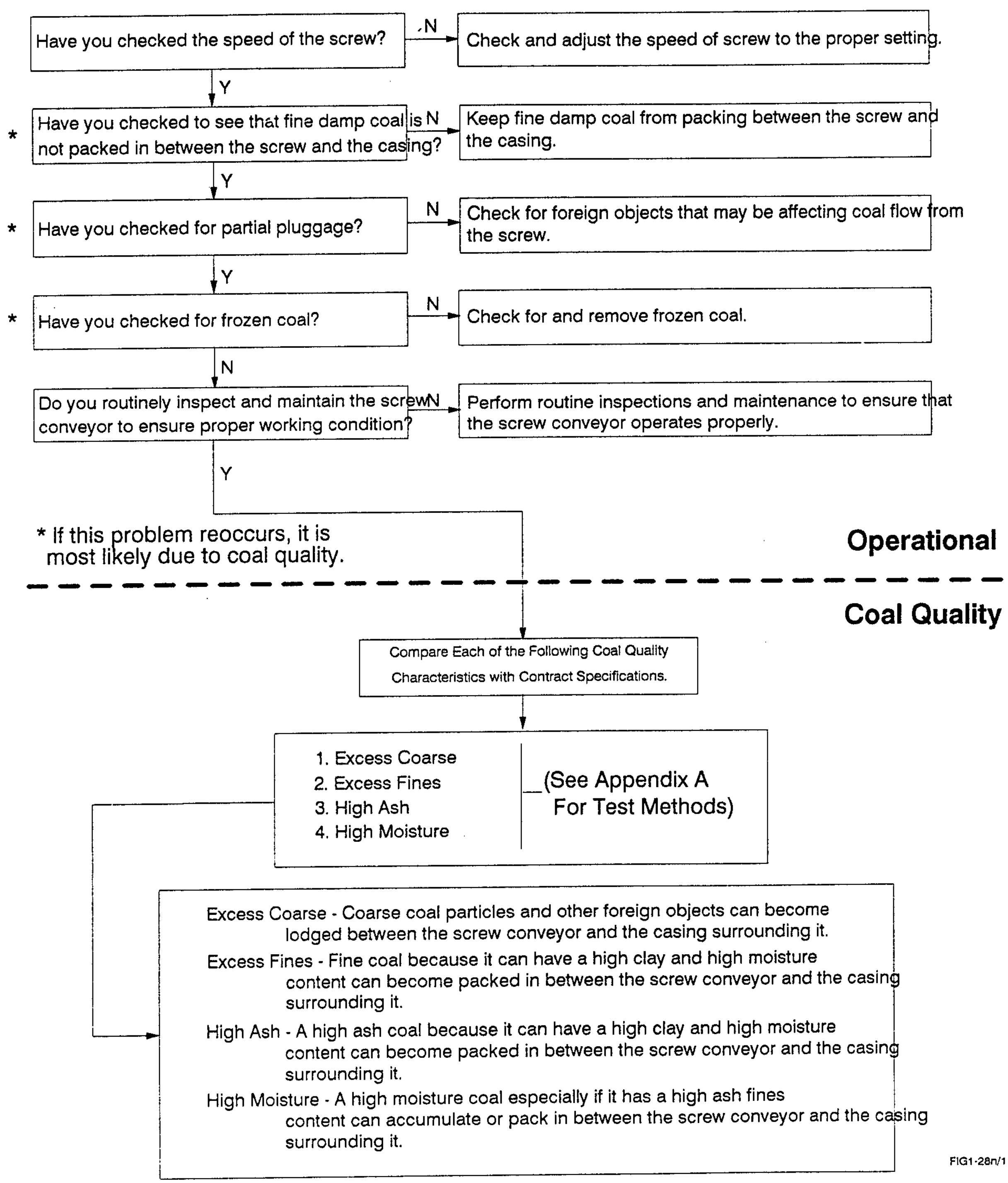


FIG1-28n/1

FIGURE 1-29: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor (Bucket Conveyor)

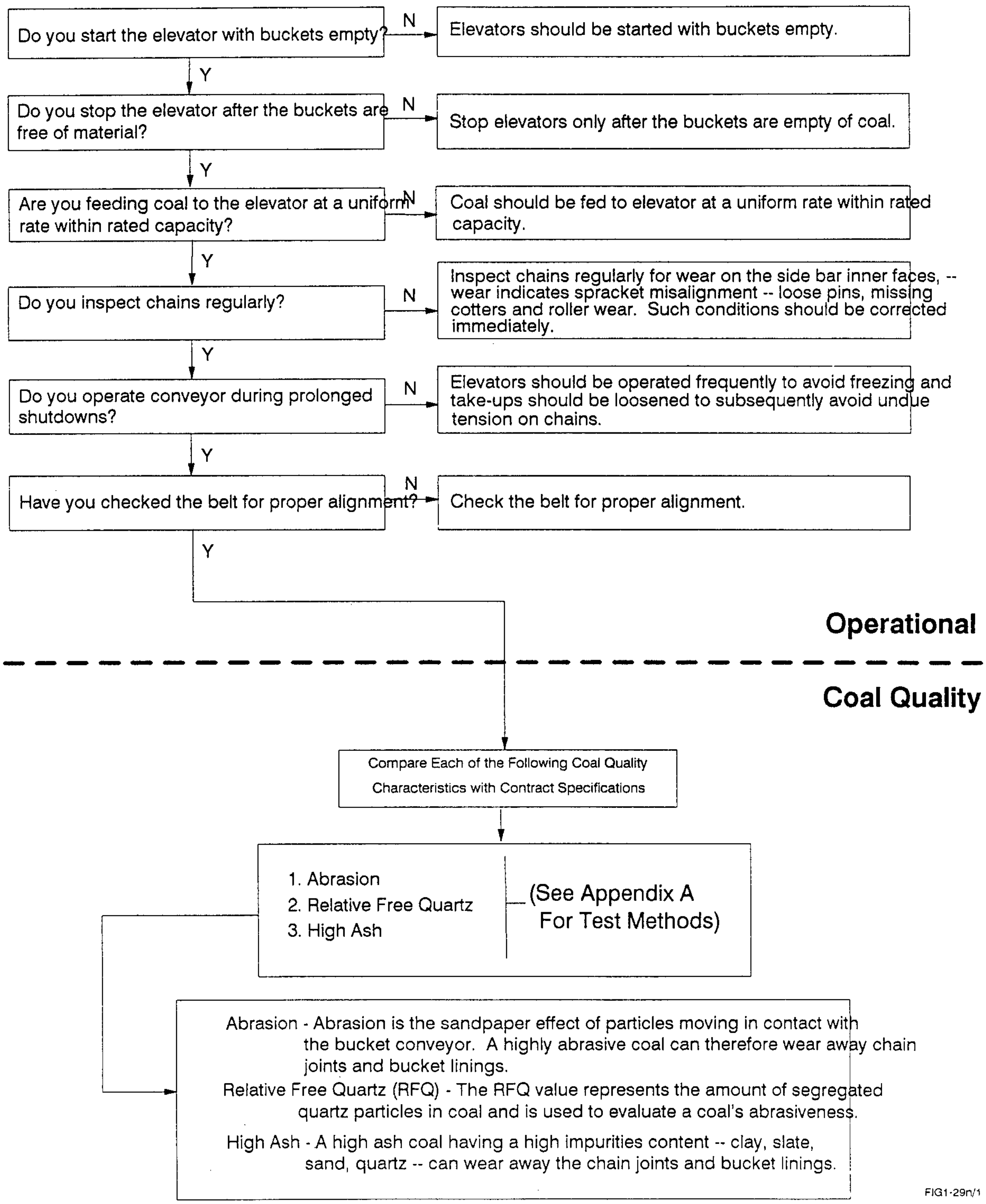


FIGURE 1-30: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Bucket Conveyor)

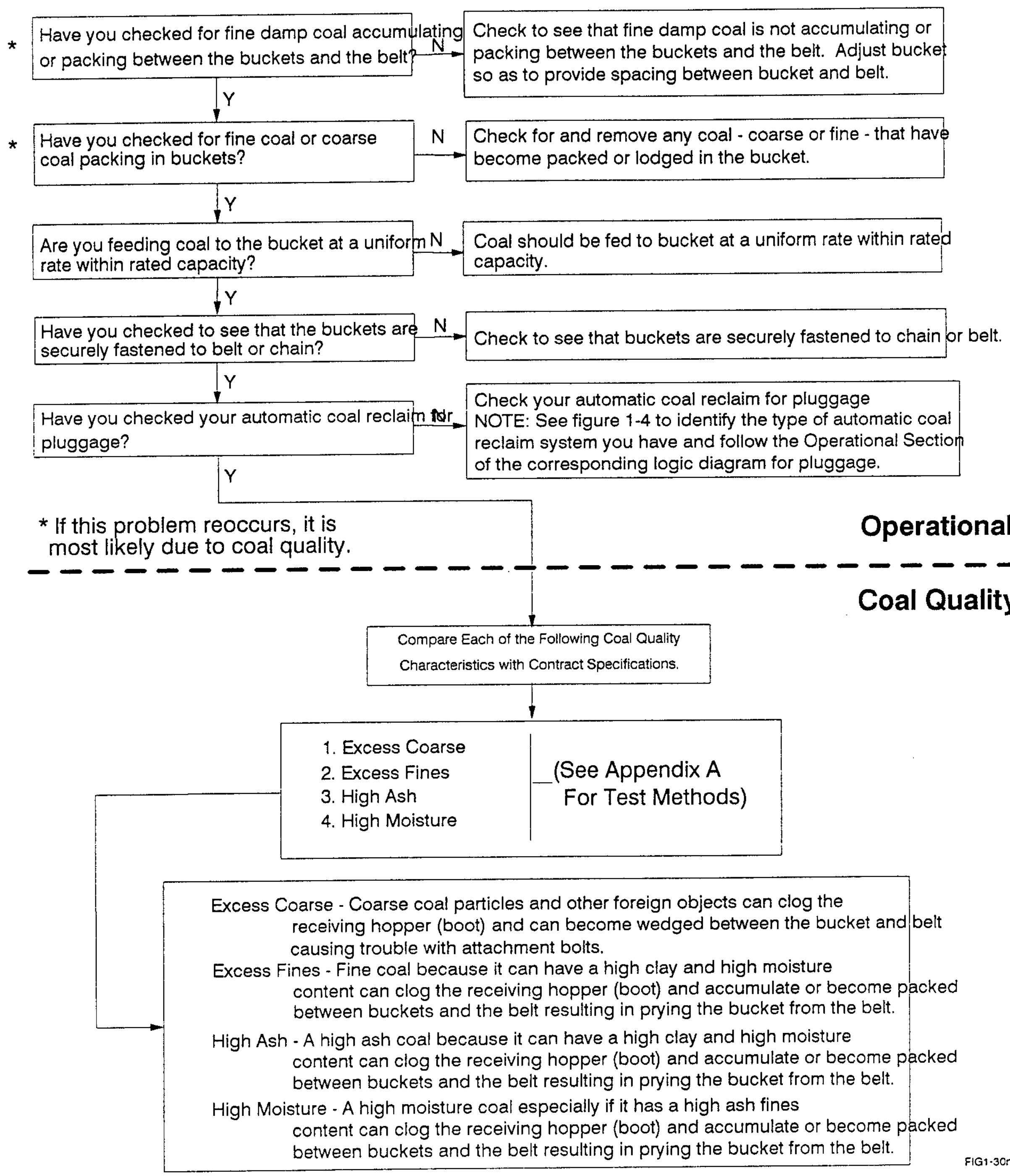


FIG1-30n/1

FIGURE 1-31: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Bucket Conveyor)

* Have you checked for fine damp coal accumulating or packing between the buckets and belt and in the buckets?
- N → Check to see that fine damp coal is not accumulated or packing between the buckets and the belt and in buckets. Adjust bucket so as to provide spacing between bucket and belt.
- Y ↓

Are you feeding coal to the buckets at a uniform rate within rated capacity?
- N → Coal should be fed to buckets at a uniform rate within rated capacity.
- Y ↓

Have you checked to see that the buckets are securely fastened to chain or belt?
- N → Check to see that buckets are securely fastened to chain or belt.
- Y ↓

Have you checked the belt for proper alignment?
- N → Check to see that the belt is in alignment with the idlers.
- Y ↓

Are you missing any buckets?
- N → Inspect conveyor and replace any worn or missing brackets.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become wedged between the bucket and belt causing trouble with attachment bolts.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

FIG1-31n/1

FIGURE 1-32: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

Erratic Feeding From The Coal Feed Conveyor (Bucket Conveyor)

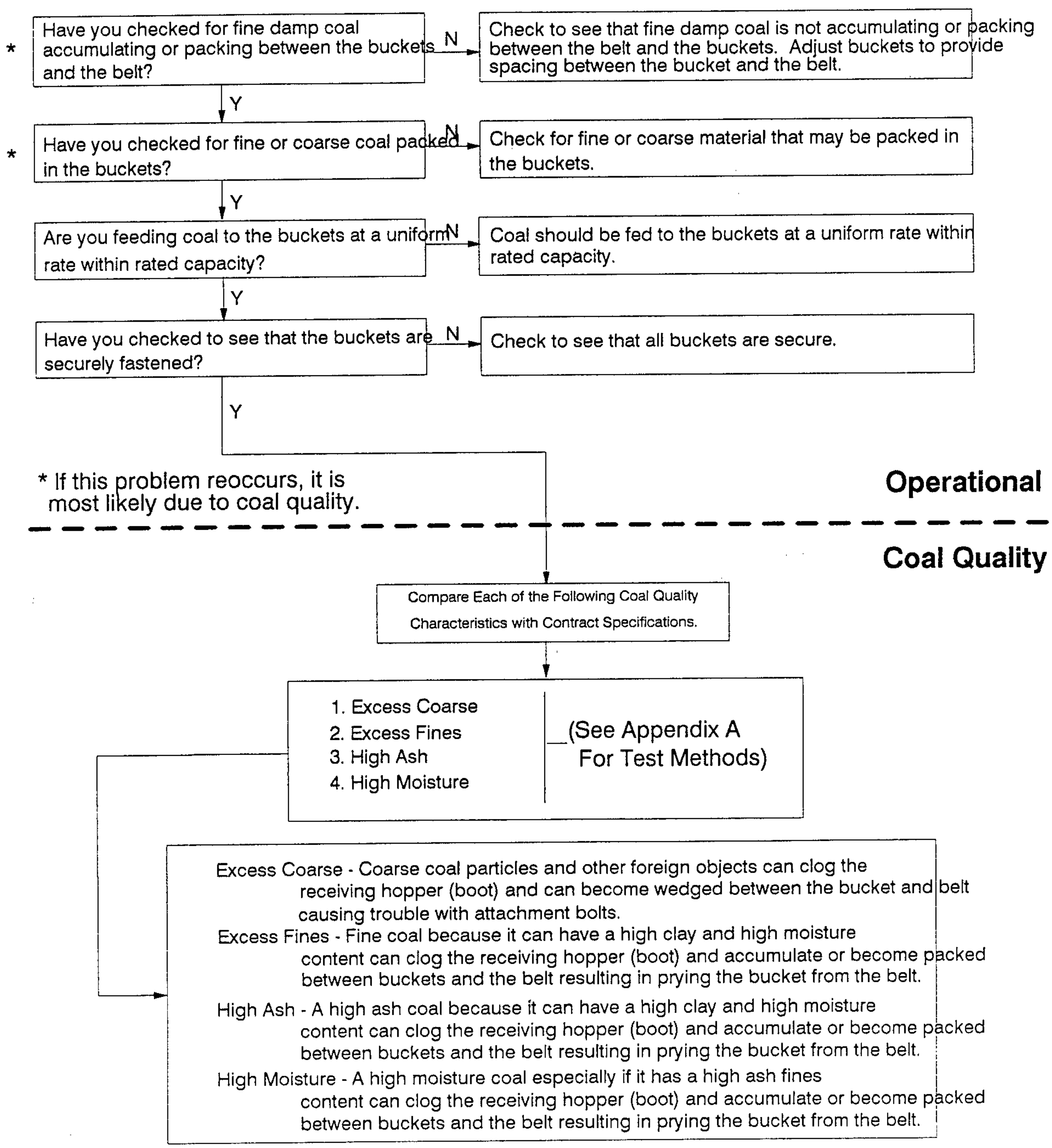


FIG1-32n/1

FIGURE 1-33: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of Coal Feed Conveyors

(Redler Conveyors)

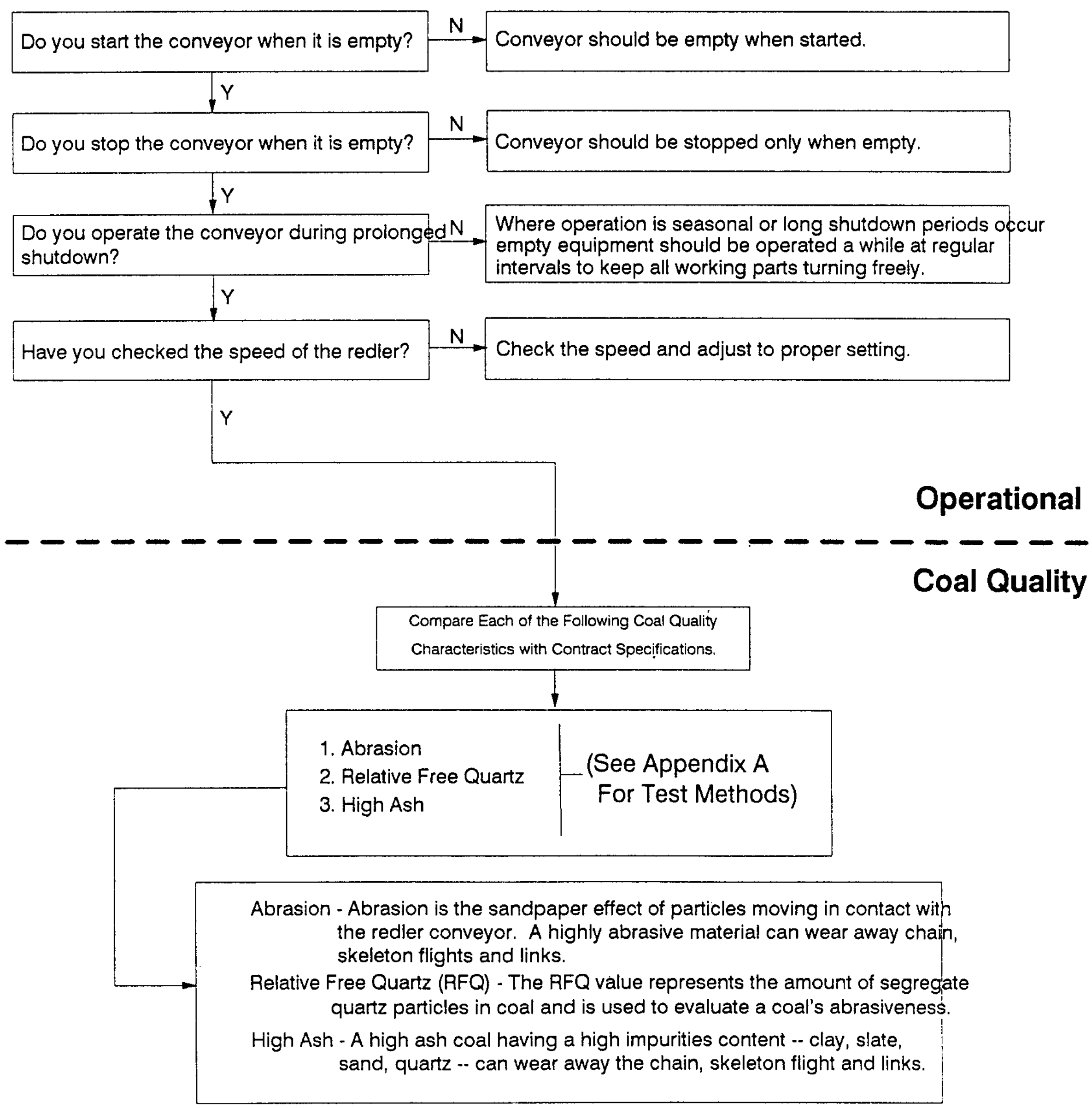


FIG1-33n/1

FIGURE 1-34: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Feed Conveyor
(Redler Conveyor)

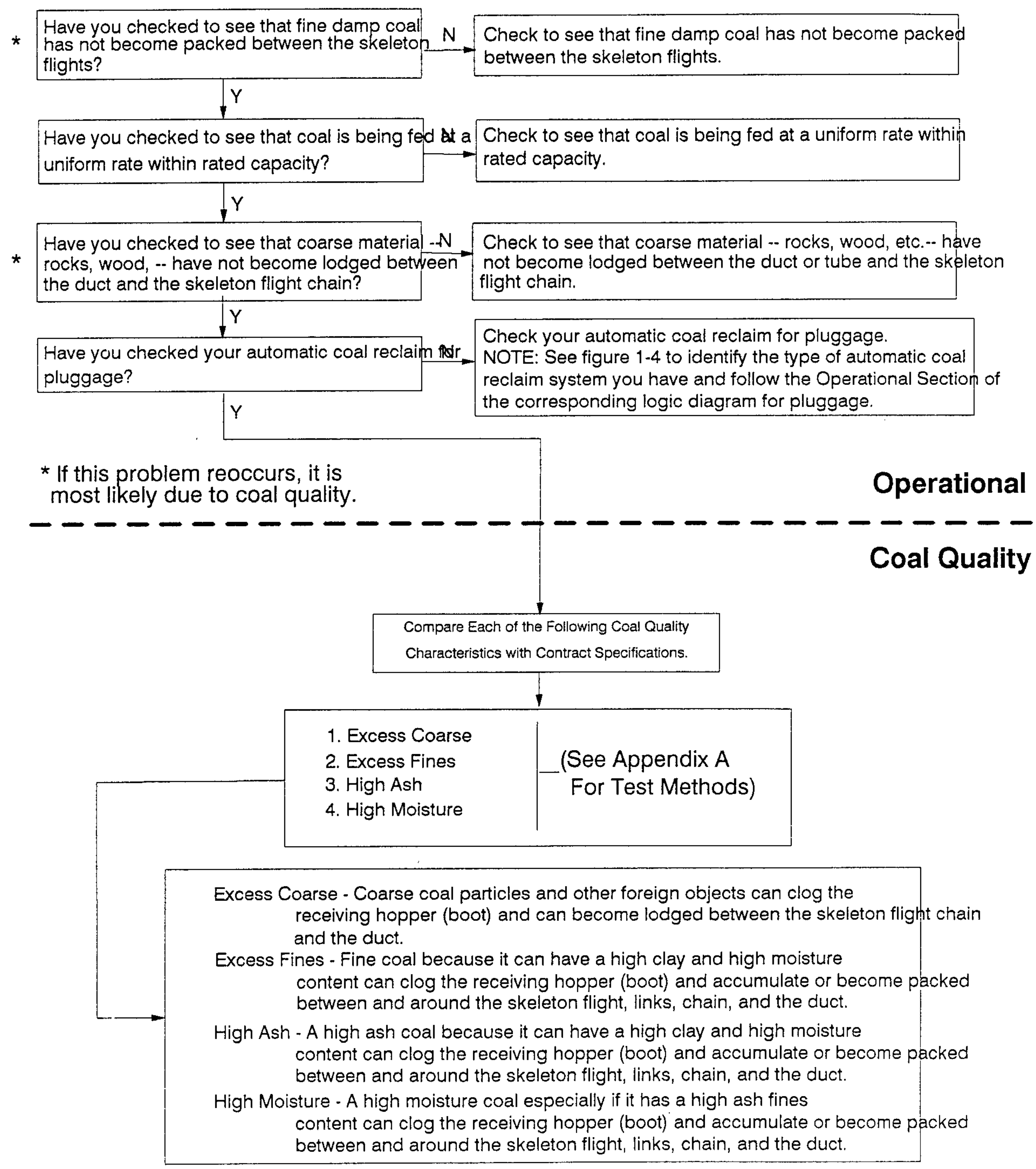


FIG1-34n/1

FIGURE 1-35: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Redler Conveyor)

* Have you checked for fine damp coal that has become packed in between the skeleton flights?
- N → Check to see that fine damp coal has not become packed between skeleton flights.
- Y ↓

* Have you checked to see that coarse material - rocks, wood, frozen coal - has not become lodged between the duct and the skeleton flight?
- N → Check to see that coarse material -- rocks, wood, frozen coal -- has not become lodged between the duct and the skeleton flights.
- Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
- N → Check to see that coal is being fed at a uniform rate within rated capacity.
- Y ↓

Have you checked the speed of the redler?
- N → Check the speed and adjust to the proper setting.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG1-35n/1

FIGURE 1-36: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Redler Conveyor)

* Have you checked that fine damp coal has not become packed between the skeleton flights?

N → Check to see that fine damp coal has not become packed between skeleton flights.

Y ↓

* Have you checked to see that rocks, wood, large coal particles have not become lodged between the duct and the skeleton flights?

N → Check to see that rocks, wood, large coal particles have not become lodged between duct and skeleton flights.

Y ↓

Have you checked to see that the coal is being fed at a uniform rate within rated capacity?

N → Check to see that coal is being fed at a uniform rate within rated capacity.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG1-36n/1

FIGURE 1-37: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Chutes)

* Have you checked for large rocks, wood, pieces of coal, frozen coal or other foreign objects preventing coal flow out of the chute?

N → Remove any large rocks, wood, pieces of coal, frozen coal or any other foreign objects that may be preventing coal flow out of the chute.

Y

* Have you checked for fine damp coal that may have accumulated or become packed in the chute?

N → Remove any fine damp coal that may have accumulated or become packed in the chute.

Y

Have you checked your automatic coal reclaim for pluggage?

N → Check your automatic coal reclaim for pluggage. NOTE: See figure 1-4 to identify the type of automatic coal reclaim system you have and follow the Operational Section of the corresponding logic diagram for pluggage.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the chute discharge opening.

FIG1-37n/1

FIGURE 1-38: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Chutes)

* Have you checked for ratholing?
N → Check for moist fine coal packed against the walls of the chute.
Y ↓

* Have you checked for partial pluggage?
N → Check to see that foreign objects are not slowing the flow of coal out of the chute.
Y ↓

* Have you checked for frozen coal?
N → Check for frozen coal that may be slowing the flow of coal out of the chute.
Y ↓

* If this problem reoccurs, it is most likely is due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate alongs chute walls and clog the chute discharge opening.

FIG1-38n/1

FIGURE 1-39: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor (Chute)

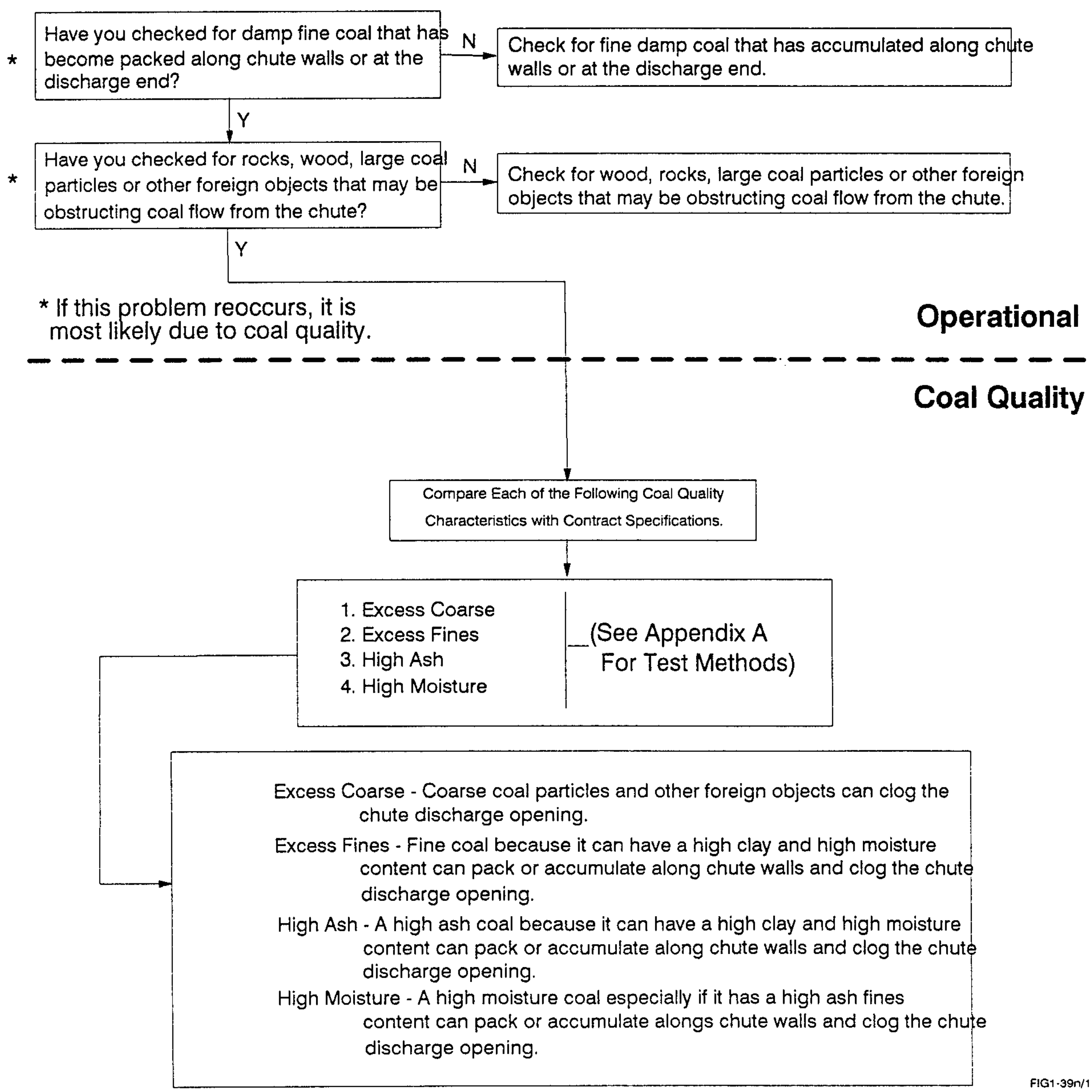


FIG1-39n/1

FIGURE 1-40: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feeders

(Chute)

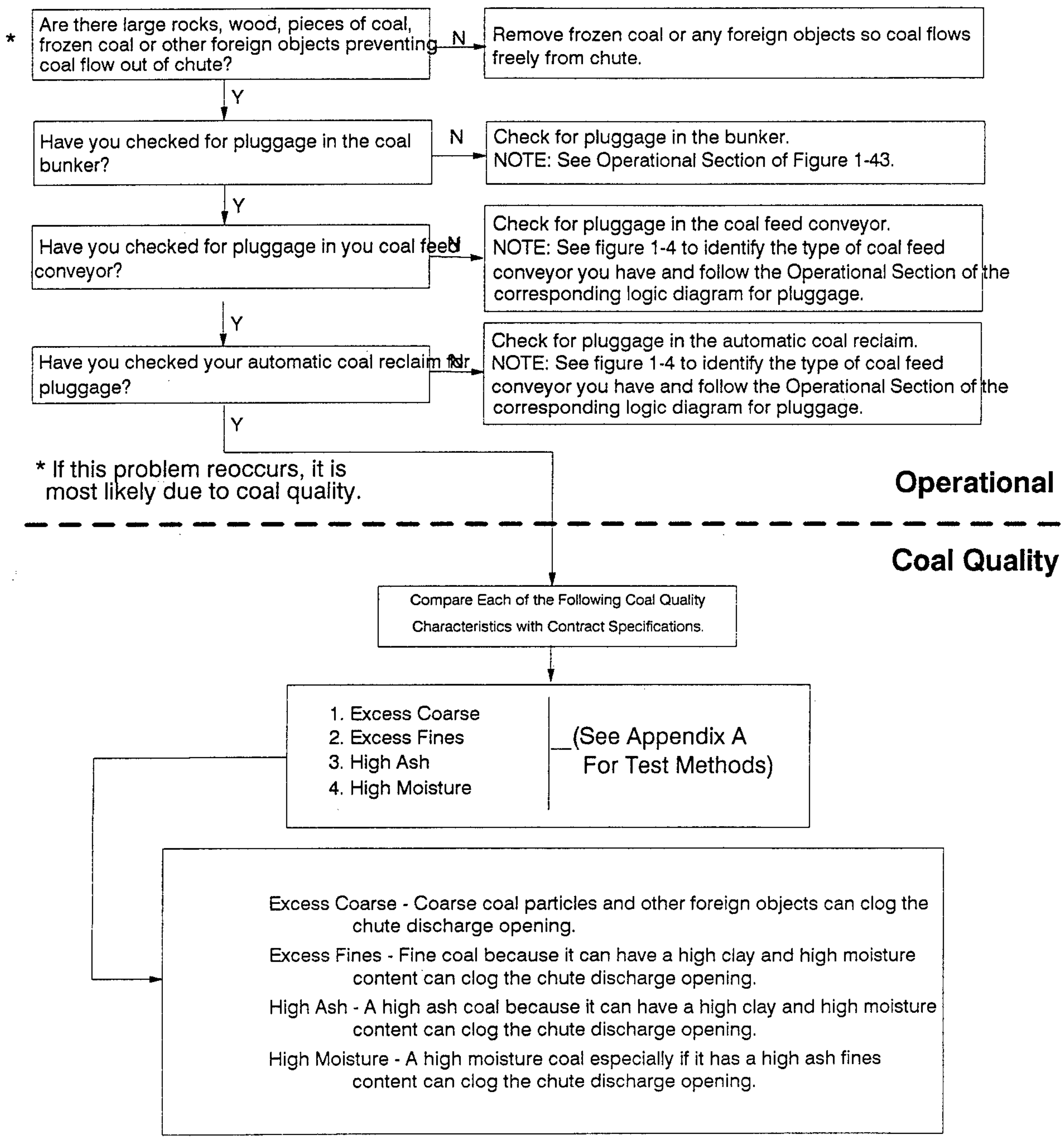


FIG1-40n/1

FIGURE 1-41: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In the Coal Feeder (Chutes)

* Have you checked for fine damp coal that has become packed along the walls in the chute?

N — Check for fine damp coal that has become packed along the walls of the chute.

Y

* Have you checked for coarse material -- rocks, wood, frozen coal, -- that is obstructing flow from the chute?

N — Check for coarse material -- rocks, wood, frozen coal -- and other foreign objects that are obstructing flow from the chutes.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate alongs chute walls and clog the chute discharge opening.

FIG1-41n/2

FIGURE 1-42: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feeder

(Chutes)

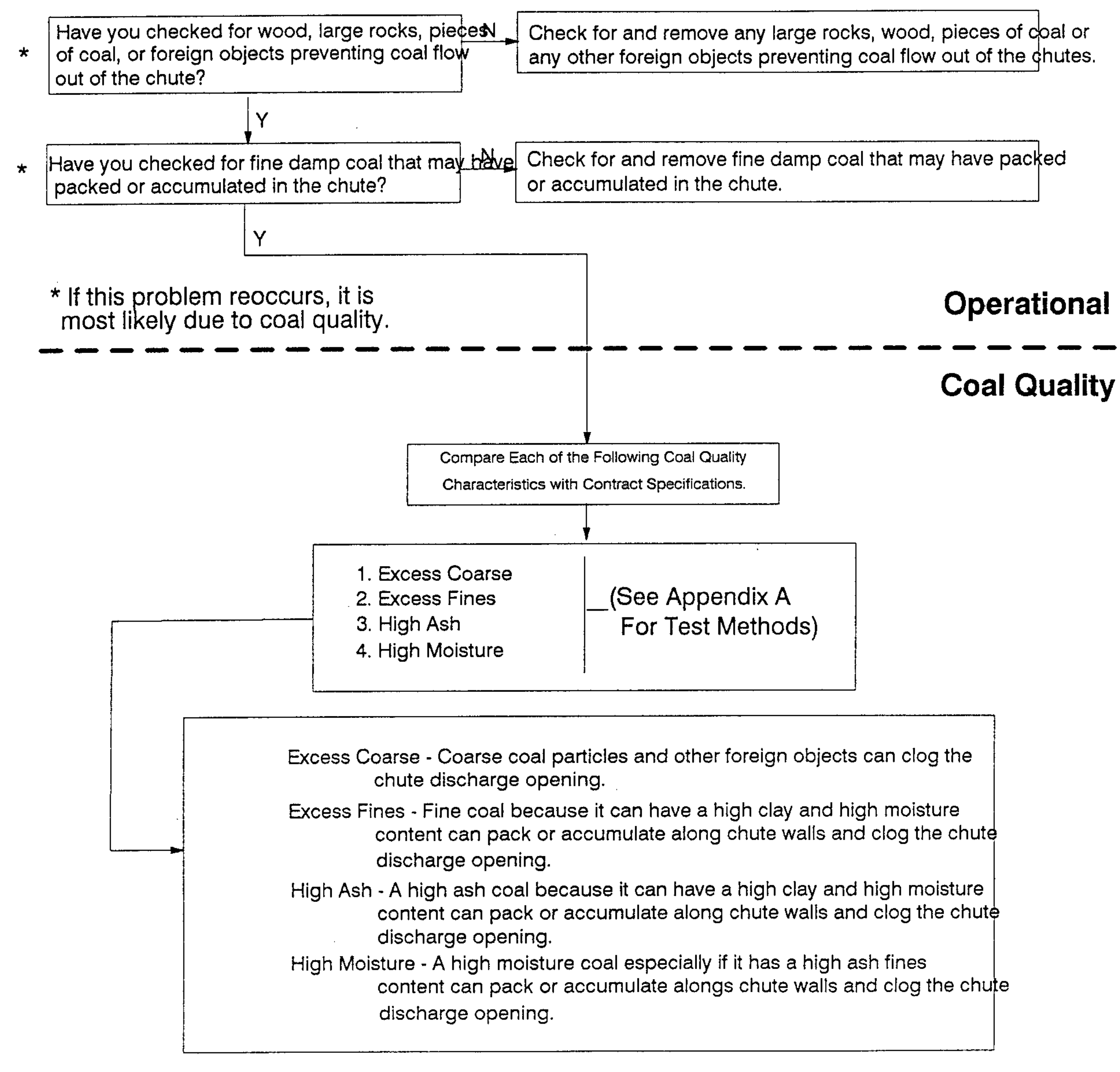


FIG1-42n/2

FIGURE 1-43: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Bunker

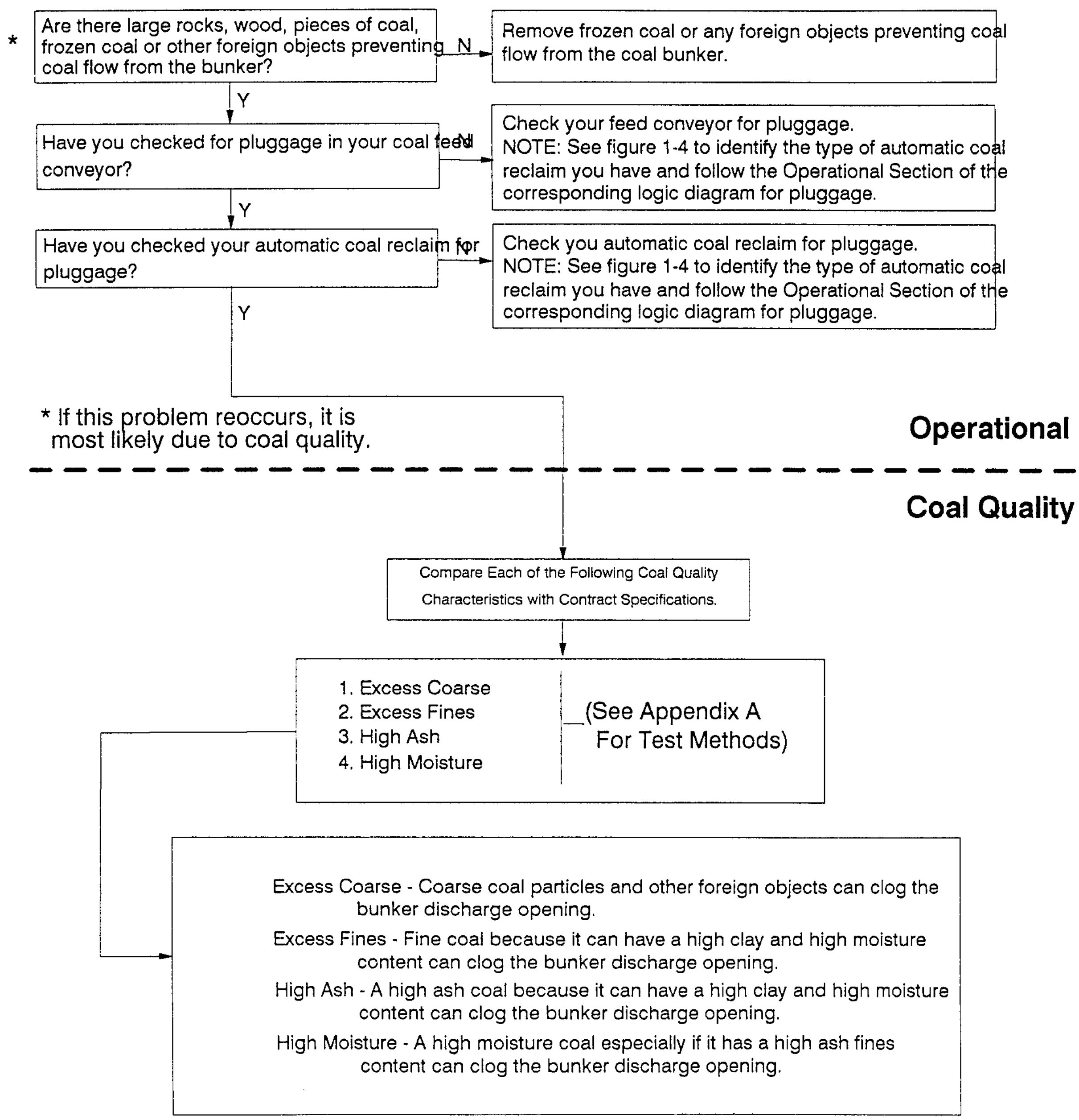


FIG1-43n/2

FIGURE 1-44: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Bunker

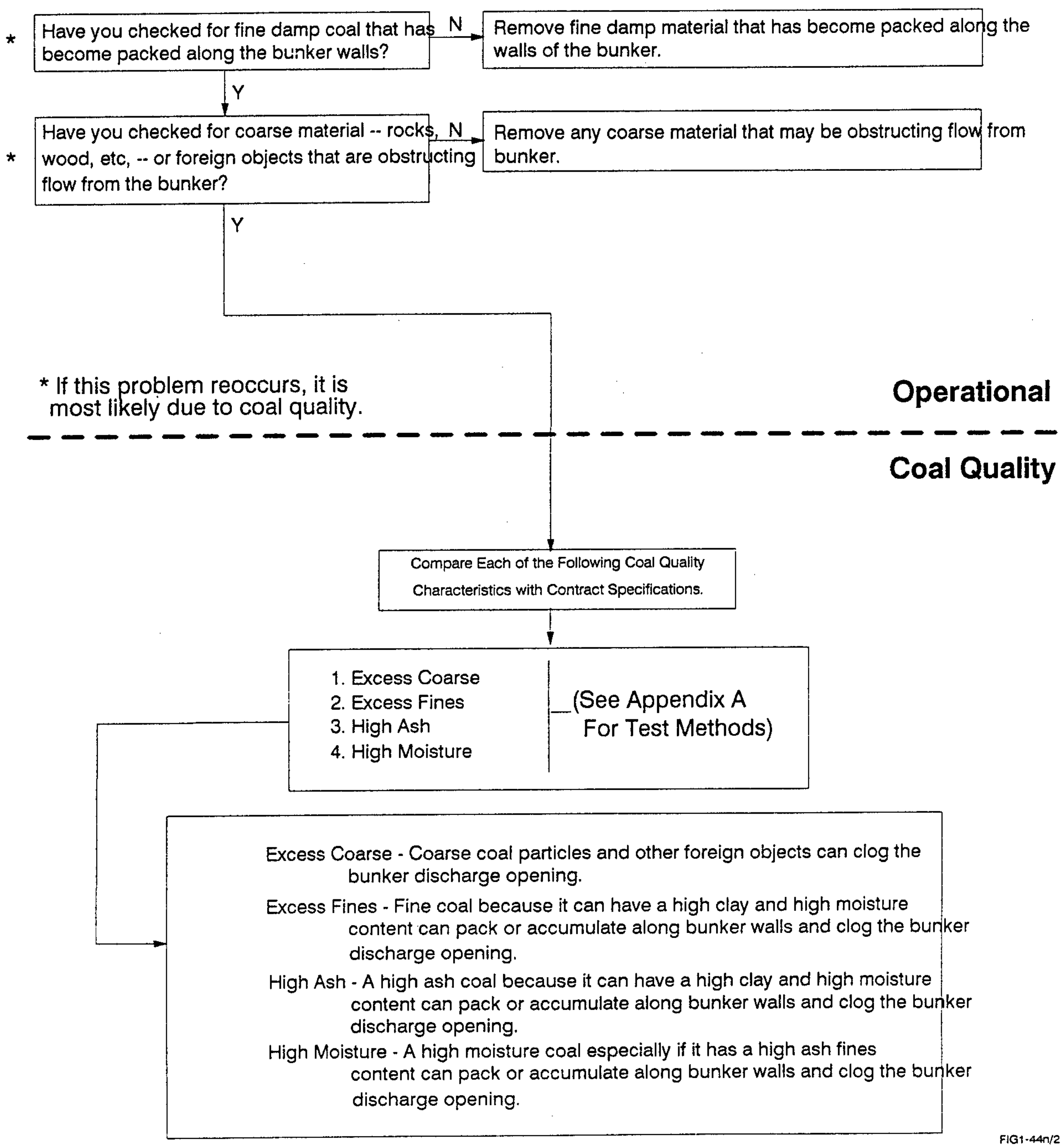


FIG1-44n/2

FIGURE 1-45: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Bunker

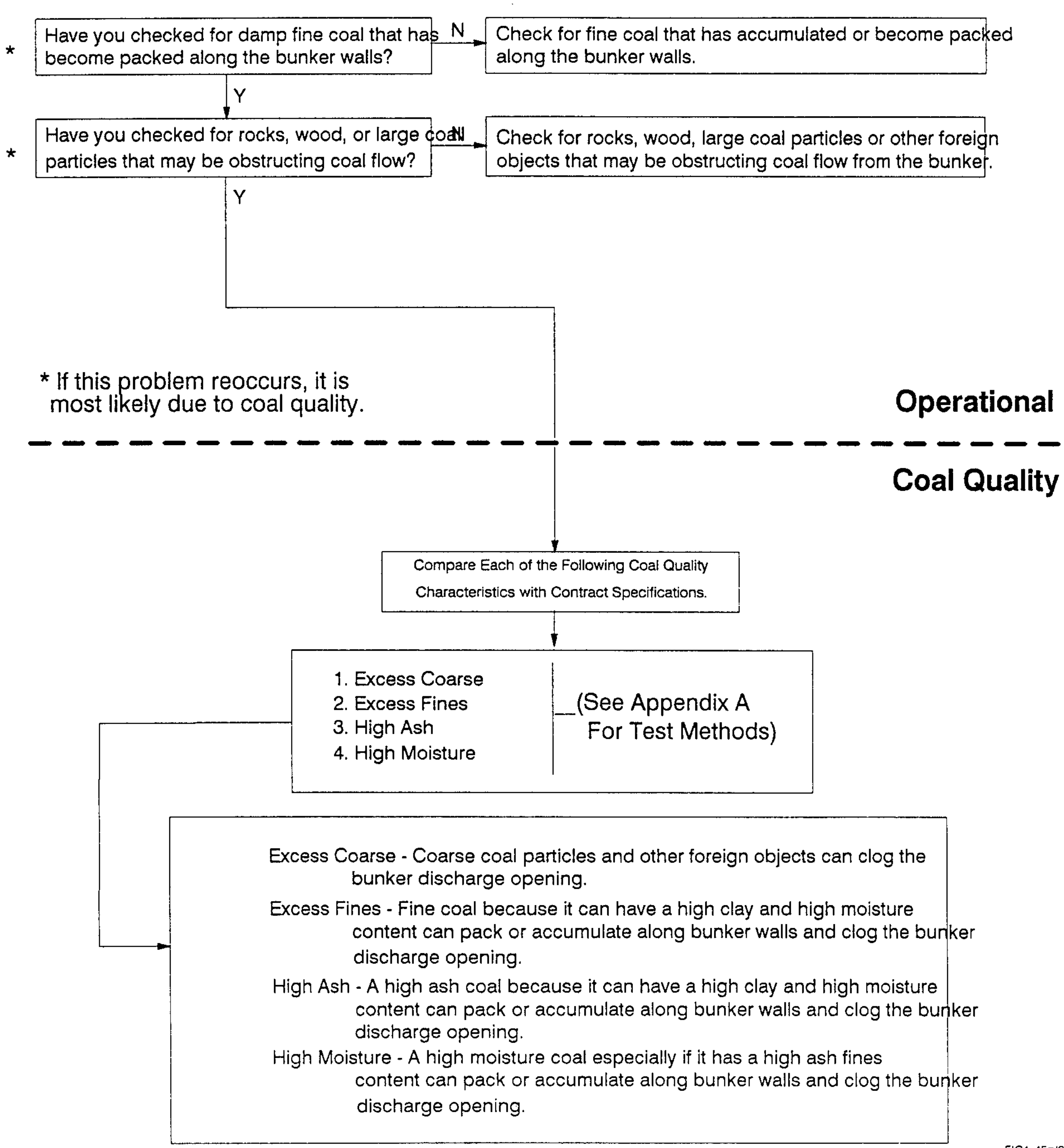


FIG1-45n/2

FIGURE 1-46: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Hopper

Does the hopper have a cut-off gate? — Y → Check to see that the gate is completely opened and secured.

N ↓

* Have you checked for large rocks, wood, pieces of coal, that are preventing coal flow onto the grate? — N → Check for and remove large rocks, wood, pieces of coal that are preventing coal flow onto the grate.

Y ↓

Have you checked for pluggage in the coal feeder? — N → Check for pluggage in the coal feeder. NOTE: See Operational Section of Figure 1-40.

Y ↓

Have you checked for pluggage in the coal bunker? — N → Check for pluggage in the coal bunker. NOTE: See Operational Section of Figure 1-43.

Y ↓

Have you checked for pluggage in you coal feed conveyor? — N → Check for pluggage in the coal feed conveyor. NOTE: See figure 1-4 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.

Y ↓

Have you checked your automatic coal reclaim for pluggage? — N → Check your automatic coal reclaim for pluggage. NOTE: See figure 1-4 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

↓

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

↓

Excess Coarse - Coarse coal particles and other foreign objects can clog the hopper discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the hopper discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the hopper discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the hopper discharge opening.

FIG1-46n/2

FIGURE 1-47: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

Insufficient Capacity In The Coal Hopper

Have you checked the level of coal in the hopper? — N → Check the level and fill the hopper with coal.

↓ Y

Does the hopper have a cut-off gate? — Y → Check to see that the cut-off gate has been opened completely and is in a secure position.

↓ N

* Have you checked for damp fine coal sticking to the hopper walls obstructing coal flow? — N → Check for fine damp coal sticking to the hopper walls obstructing coal flow.

↓ Y

* Have you checked for rocks, wood, or large coal particles or foreign objects preventing coal flow? — N → Check for rocks, wood, large coal particles or other foreign objects that may be preventing coal flow?

↓ Y

Have you checked the coal regulating gate? — N → Check and adjust the position of the coal regulating gate.

↓ Y

Do you have a chain and traveling grate? — Y → Check and adjust the grate speed to the proper setting.

↓ N

Do you have a vibrating grate? — Y → Check and adjust the interval and duration of vibrations.

↓ N

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the hopper discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can pack or accumulate along hopper wall and clog the hopper discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can pack or accumulate along hopper wall and clog the hopper discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate along hopper wall and clog the hopper discharge opening.

FIG1-47n/2

FIGURE 1-48: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Hopper

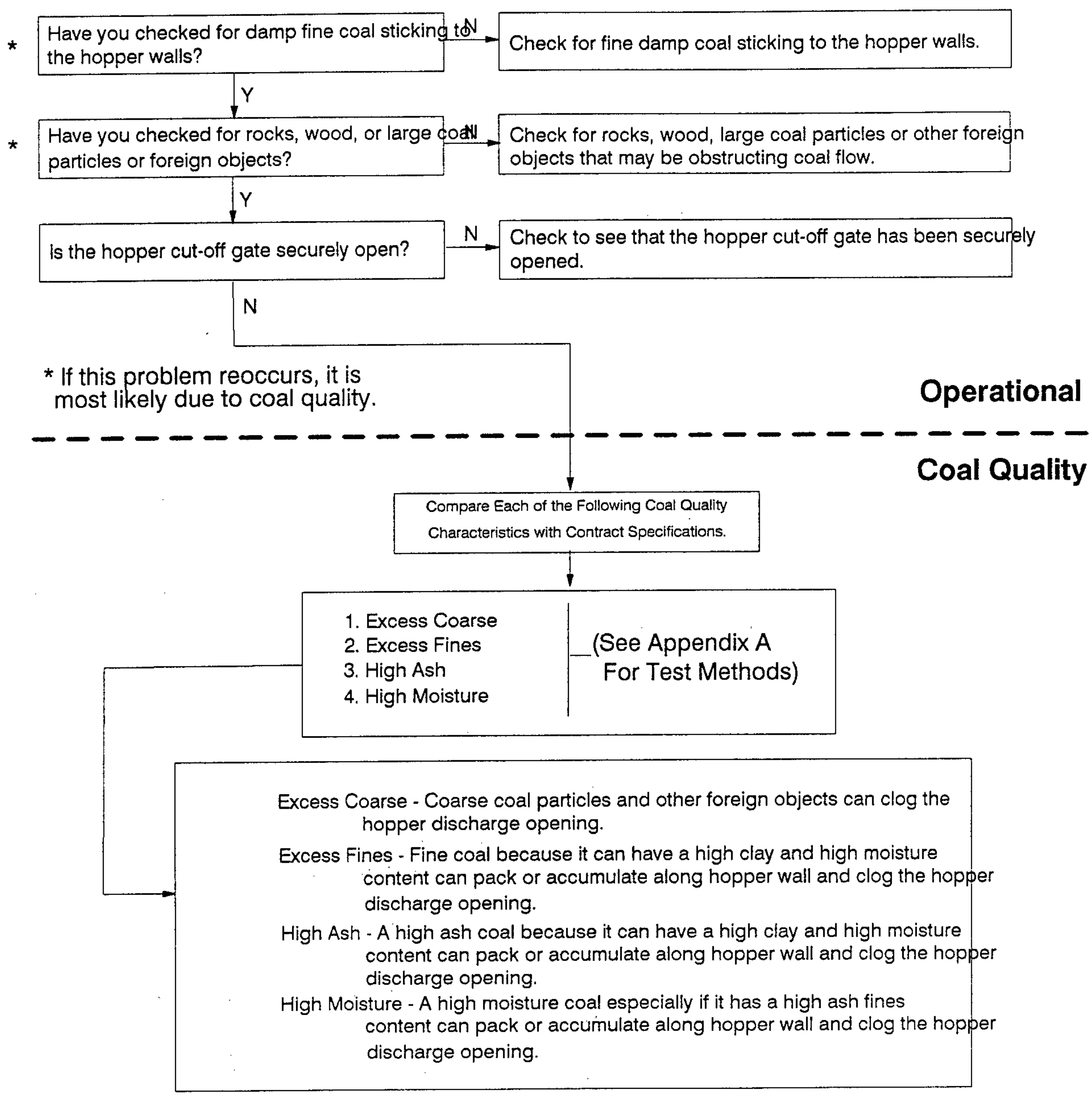


FIG1-48n/2

FIGURE 1-49: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Regulating Gate

* Have you checked to see that fine damp coal is not packed in between the grate and the gate?

N → Check to see that fine damp coal is not packed in between the grate and the gate.

Y ↓

Have you checked to see that the gate is at the proper setting?

N → Check and adjust if necessary the gate to the proper distance above the grate.

Y ↓

Do you have a chain and traveling grate?

Y → Check and adjust grate speed so coal flows freely underneath gate.

N ↓

Do you have a vibrating grate?

Y → Check and adjust the interval and duration of the vibration until coal is evenly distributed onto grate.

N ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion- Abrasion is the sandpaper effect of solid particles moving parallel to and in contact with the coal regulating gate. A highly abrasive coal can therefore wear away the gate surface.

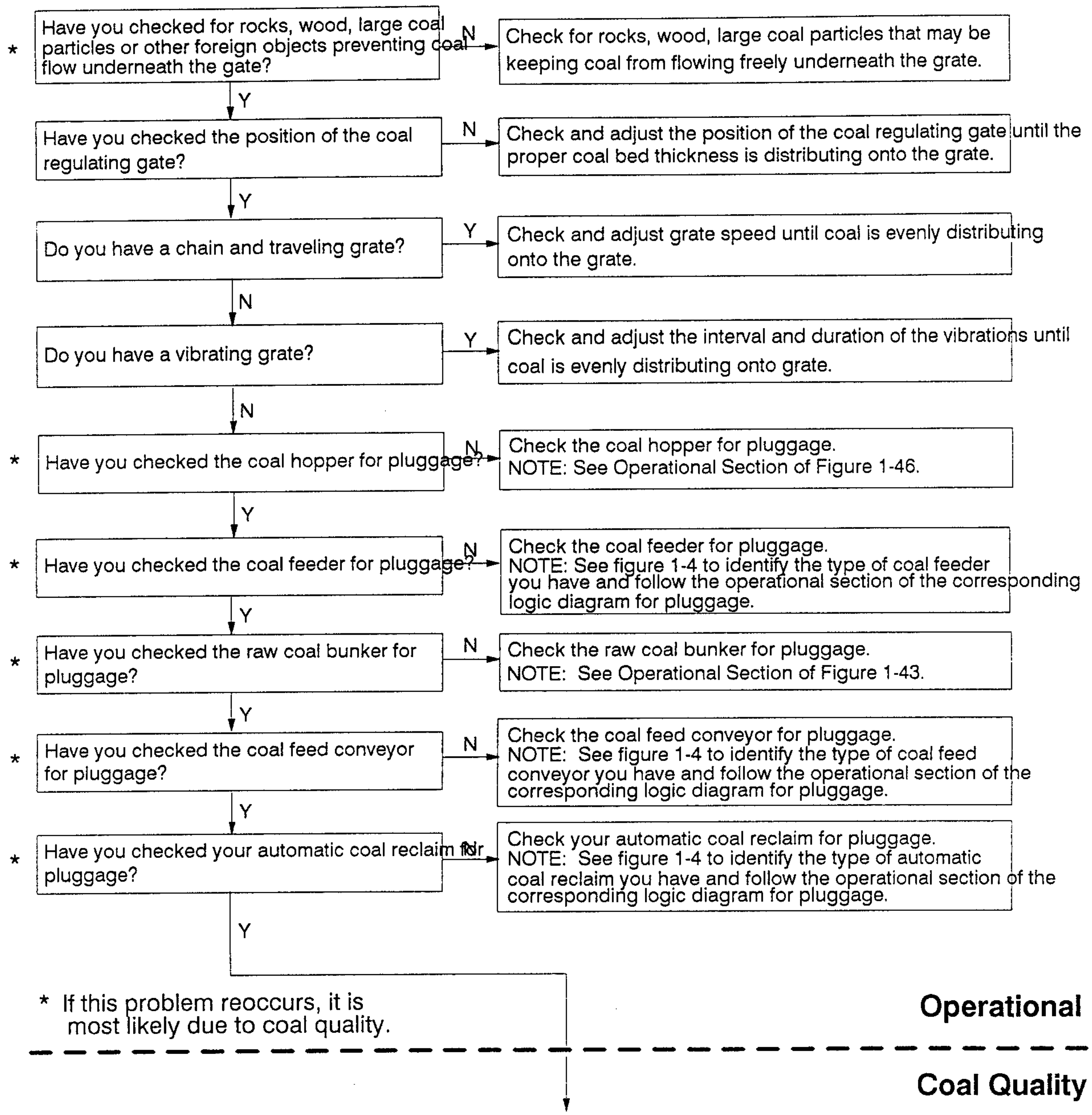
Relative Free Quartz (RFQ)- The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash- A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can also wear away metal surfaces as it comes in contact with the gate.

FIG1-49N/2

FIGURE 1-50: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Regulating Gate



See next page for Coal Quality Section

FIG1-50N/2

FIGURE 1-50 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Regulating Gate

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse- Coarse coal particles not able to pass underneath a properly adjusted gate can become lodged between the gate and the grate preventing coal flow.

Excess Fines- Fine coal because it can have a high clay and high moisture content can become packed around the gate or between the gate and the grate preventing coal flow.

High Ash- A high ash coal because it can have a high clay and a high moisture content can become packed around the gate and between the gate and the grate preventing coal flow.

High Moisture- A high moisture coal especially if it has a high ash fines content can accumulate or pack around the gate and between the gate and the grate preventing coal flow.

FIG1-50BN/2

FIGURE 1-51: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Regulating Gate

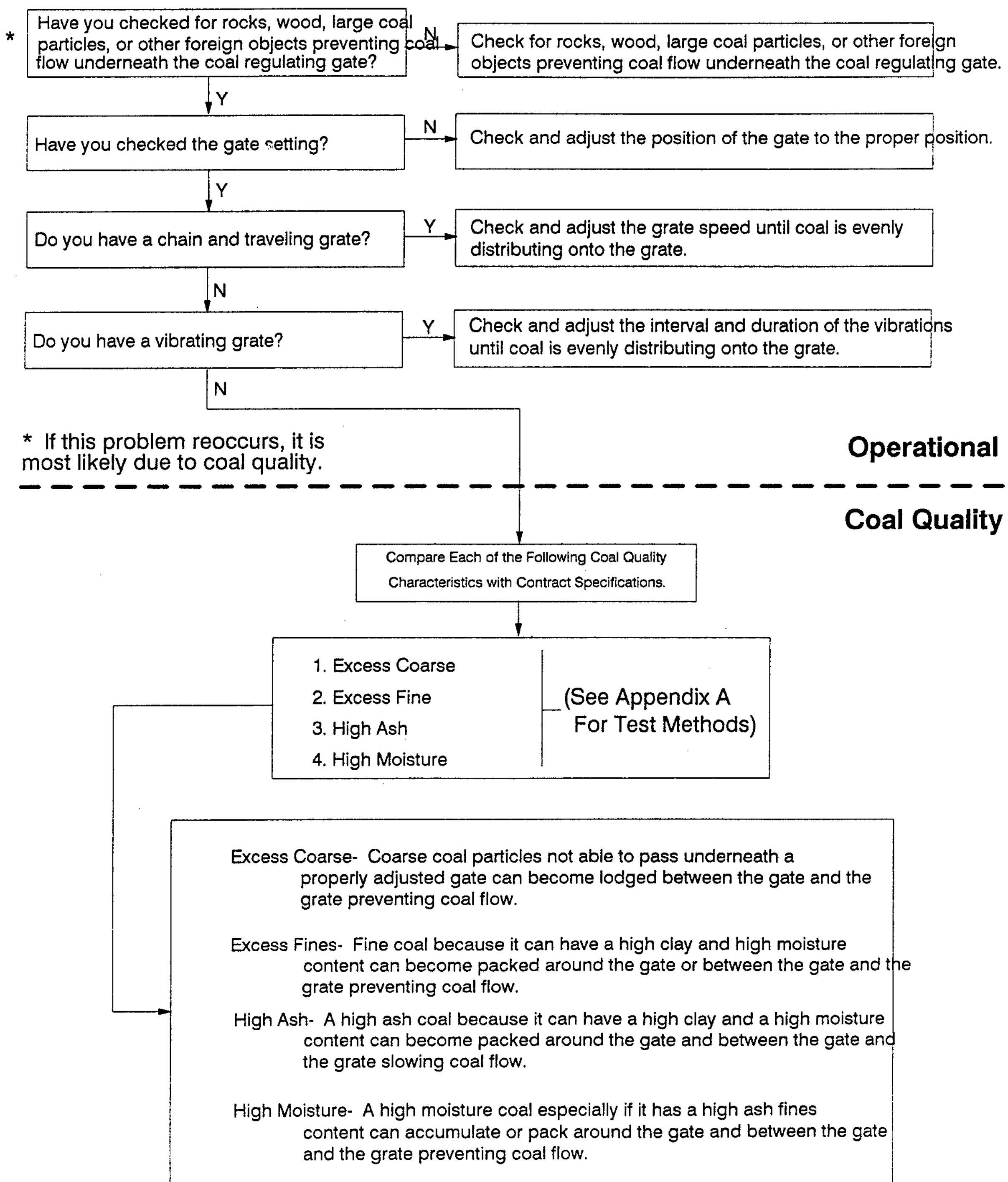


FIG1-51N/2

FIGURE 1-52: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Regulating Gate

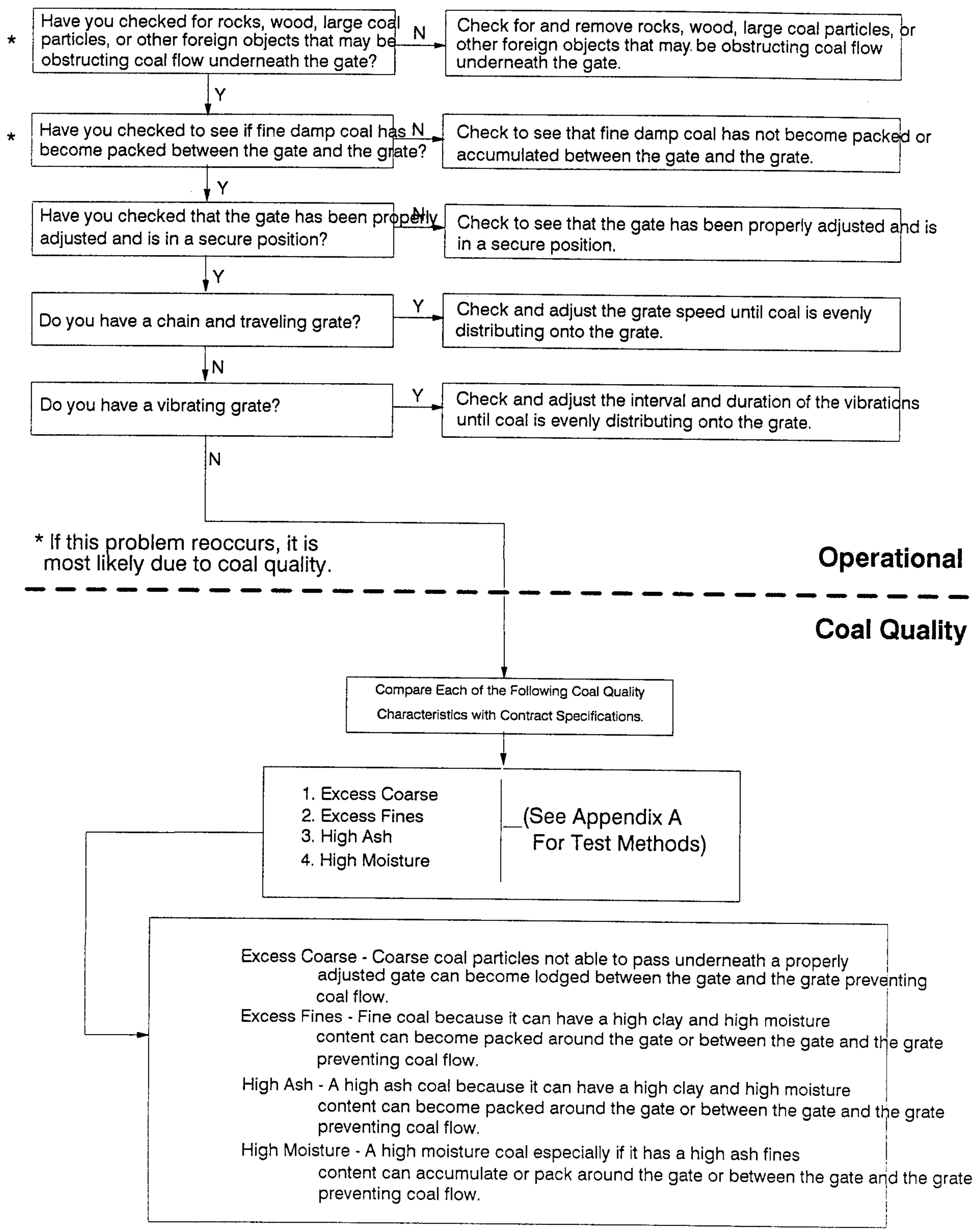
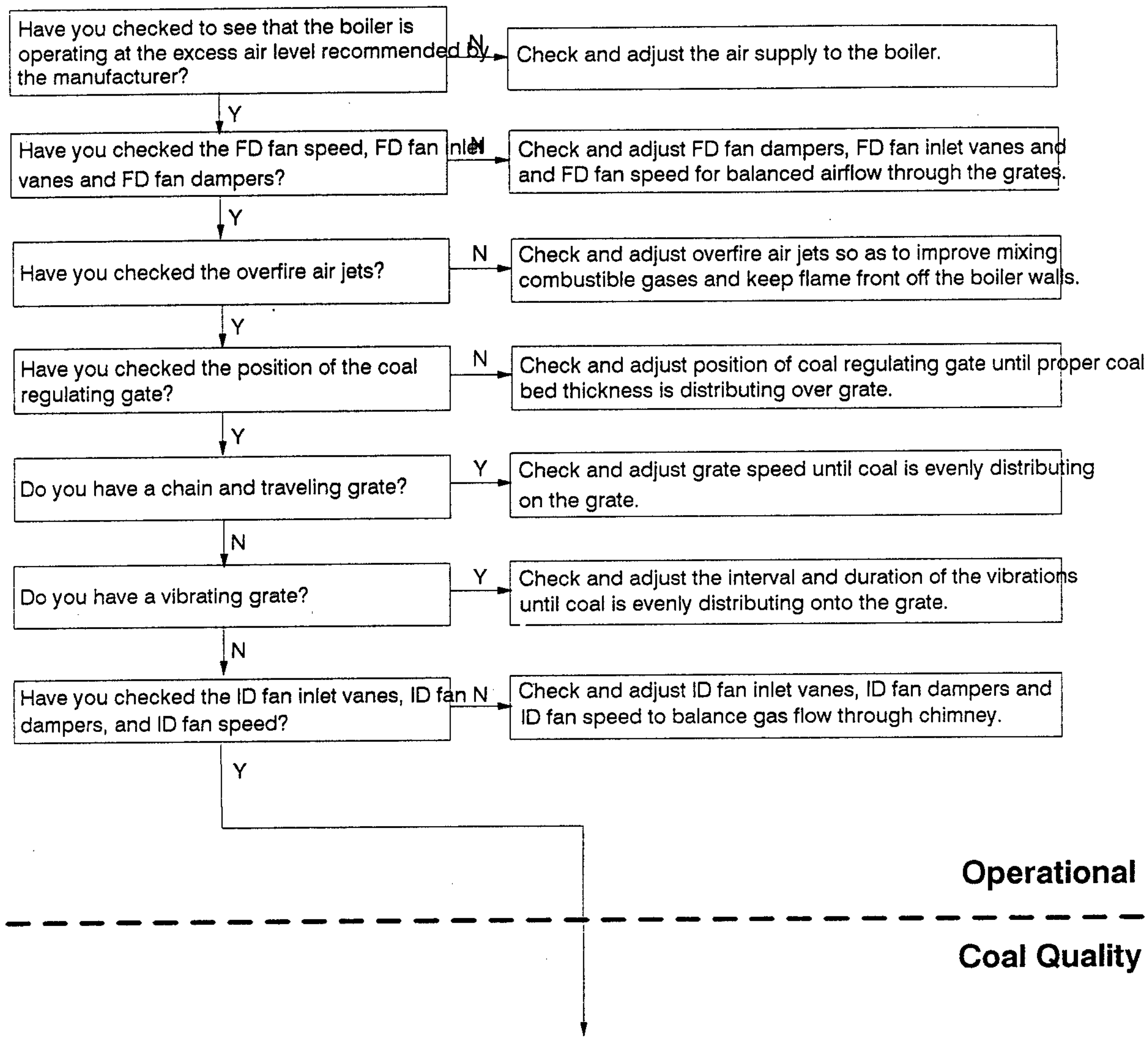


FIG1-52n/2

FIGURE 1-53: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load
(Boiler)



See next page for Coal Quality Section.

FIG1-53n/2

FIGURE 1-53 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. High ASH
5. Excess Coarse
6. Excess Fine
7. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

High Ash - If excessive ash particles can become sufficiently thick on the grate to seriously restrict air flow through the grate and fuel bed making it difficult to complete combustion.

Excess Coarse - Coarse coal tends to segregate in coal conveying equipment and hoppers causing uneven burning, an uneven ash and coal bed on the grate.

Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG1-53nb/2

FIGURE 1-54: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Reduced Boiler Efficiency

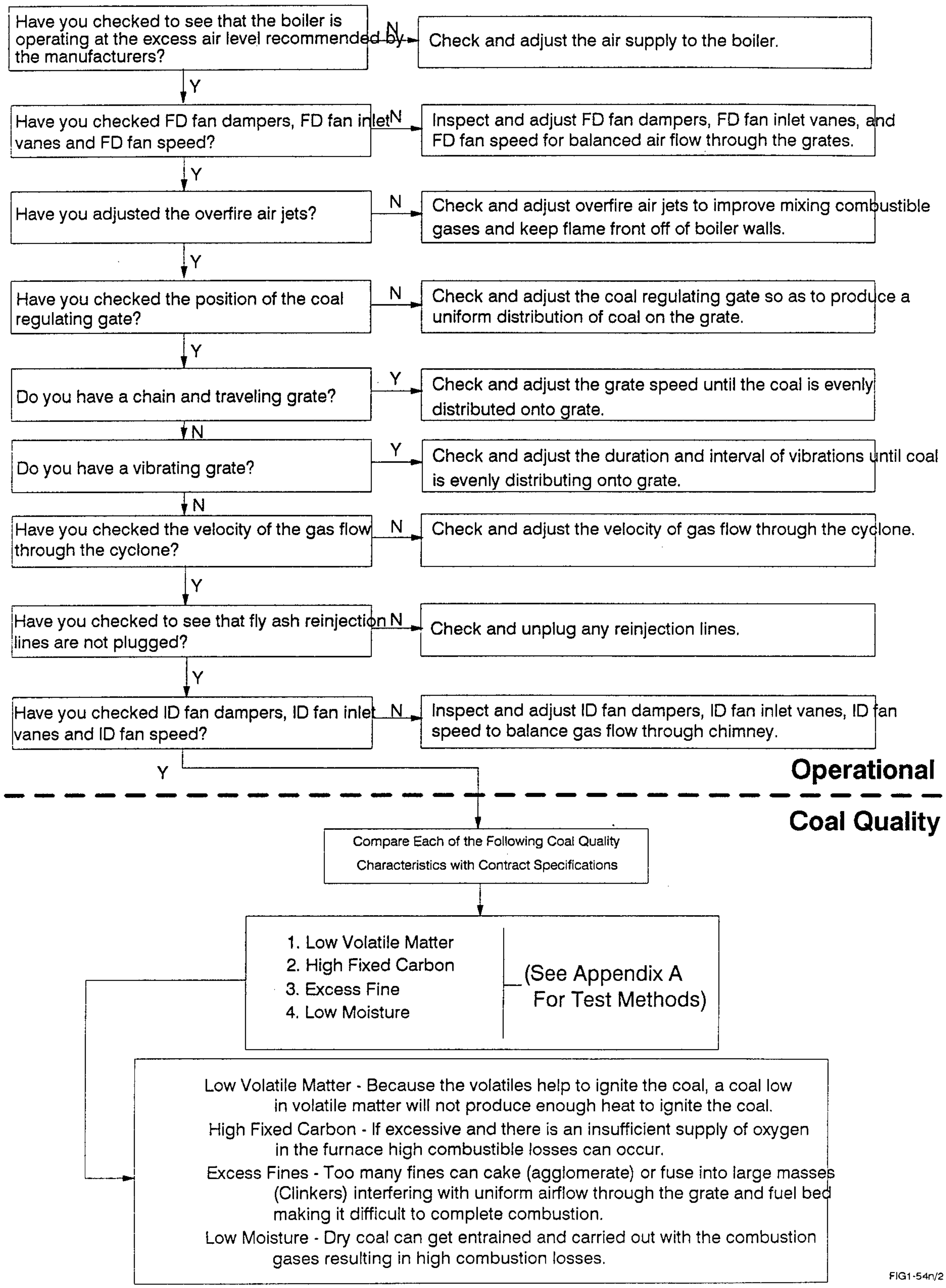


FIGURE 1-55: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Boiler Components

(Chain and Traveling Grate, and Vibrating Grate)

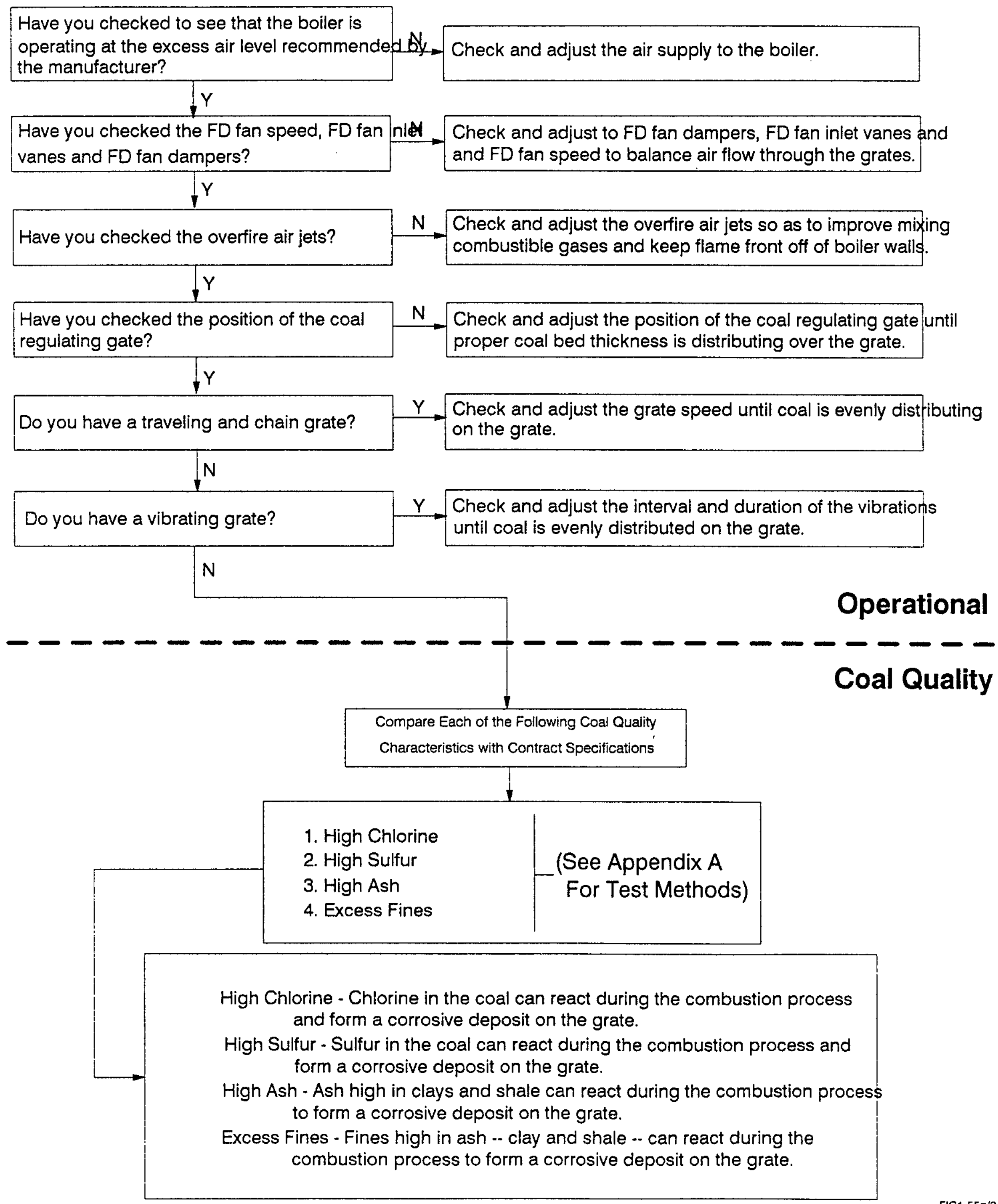


FIG1-55n/2

FIGURE 1-56: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Segregation On The Grate

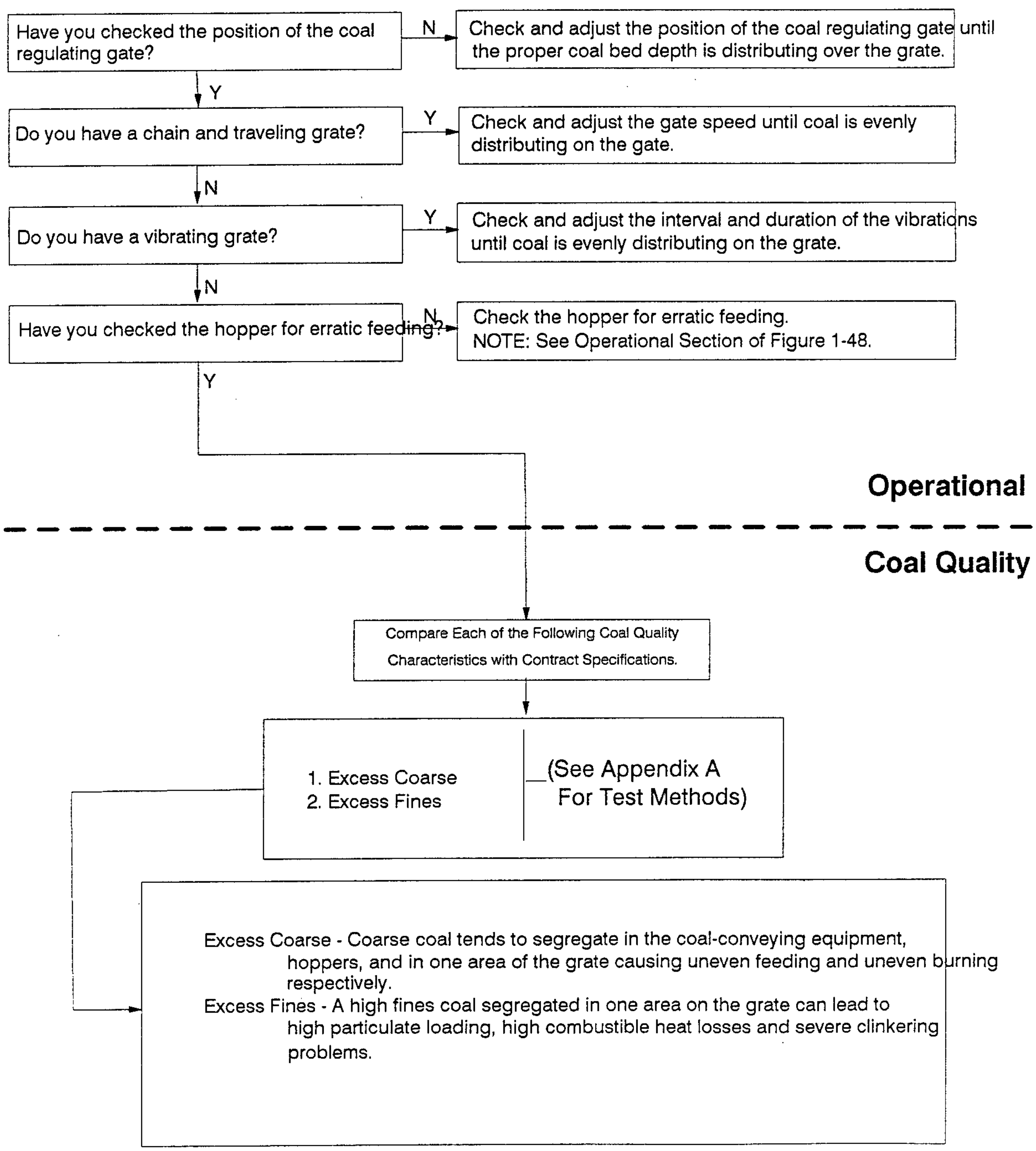


FIG1-56n/2

FIGURE 1-57: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pressure Drop Across The Grates

(Chain And Traveling Grate, Or Vibrating Grate)

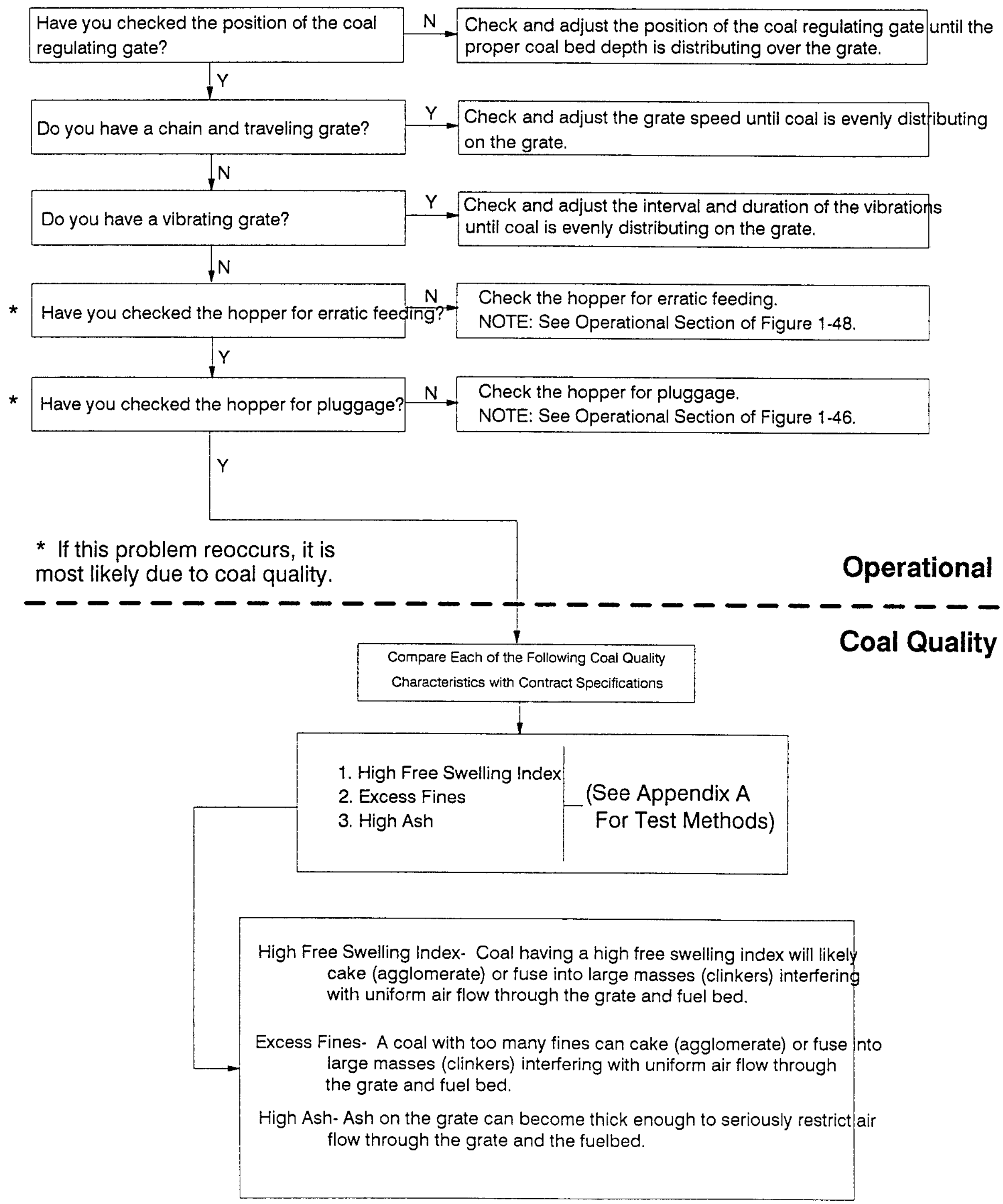


FIG1-57/2

FIGURE 1-58: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Ash Bed On The Grates

(Chain And Traveling Grate Or Vibrating Grate)

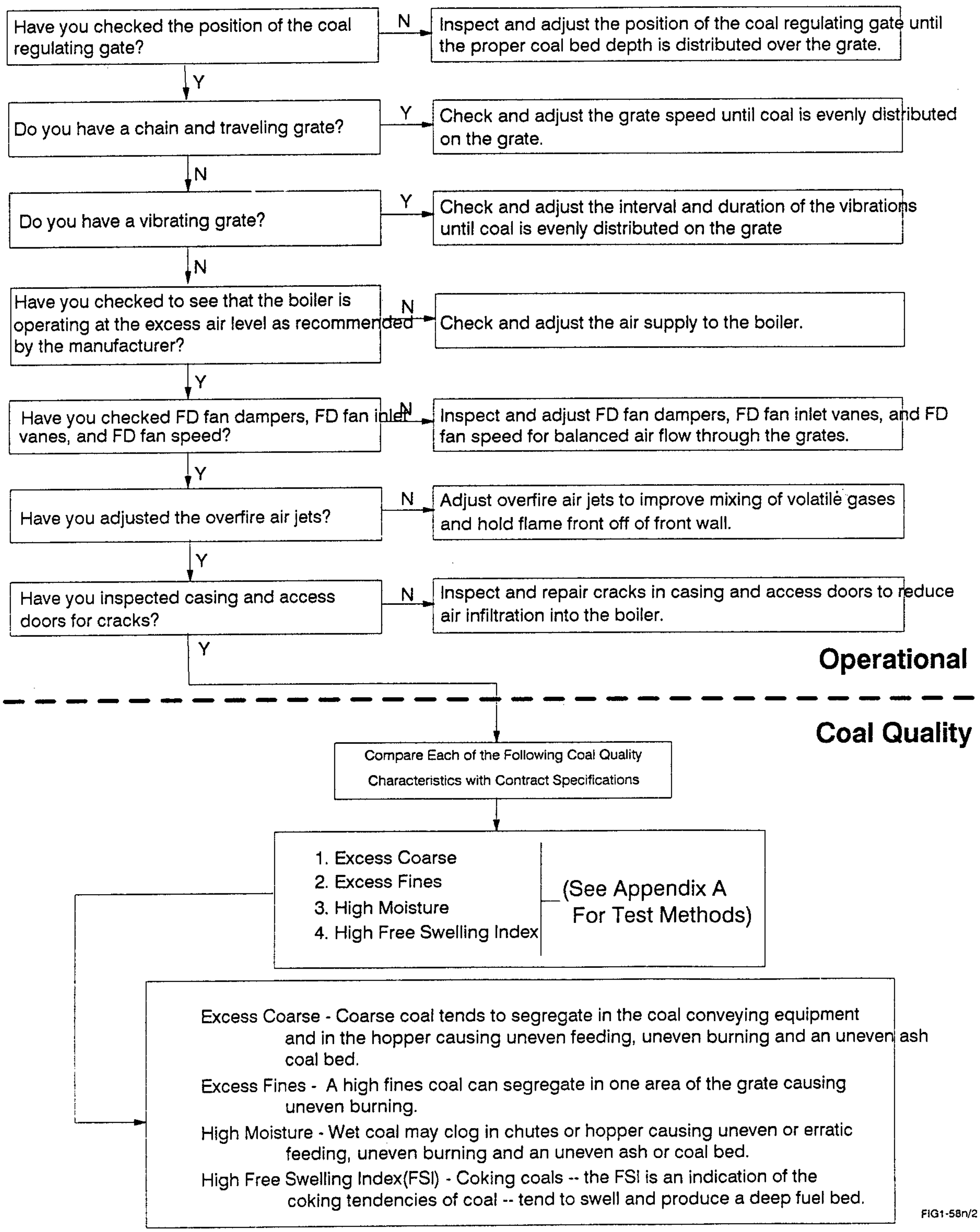


FIGURE 1-59: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Coal Bed On The Grates
(Chain and Traveling Grate Or Vibrating Grate)

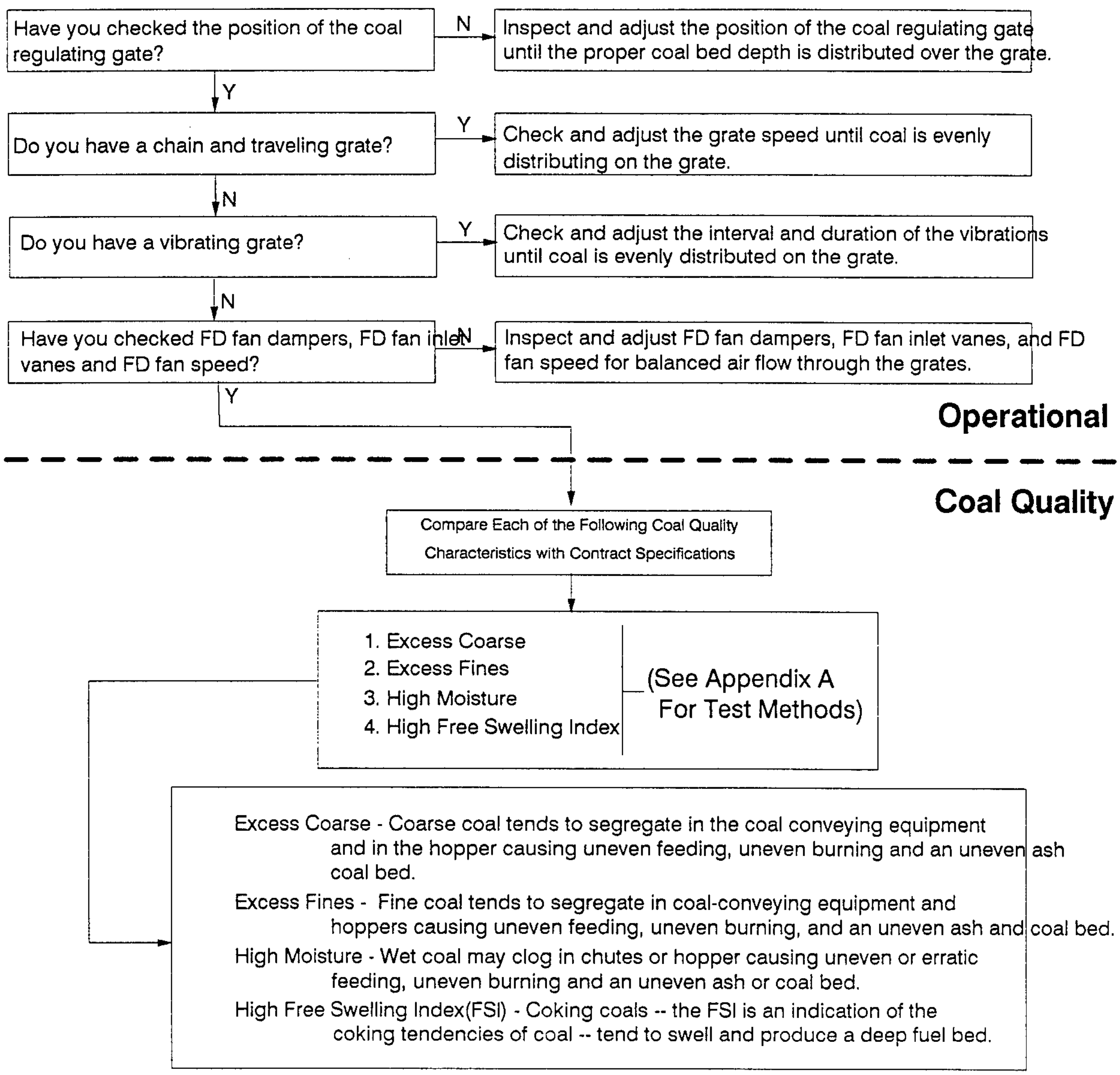


FIG1-59n/2

FIGURE 1-60: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Burning On The Grates
(Chain And Traveling Grate Or Vibrating Grate)

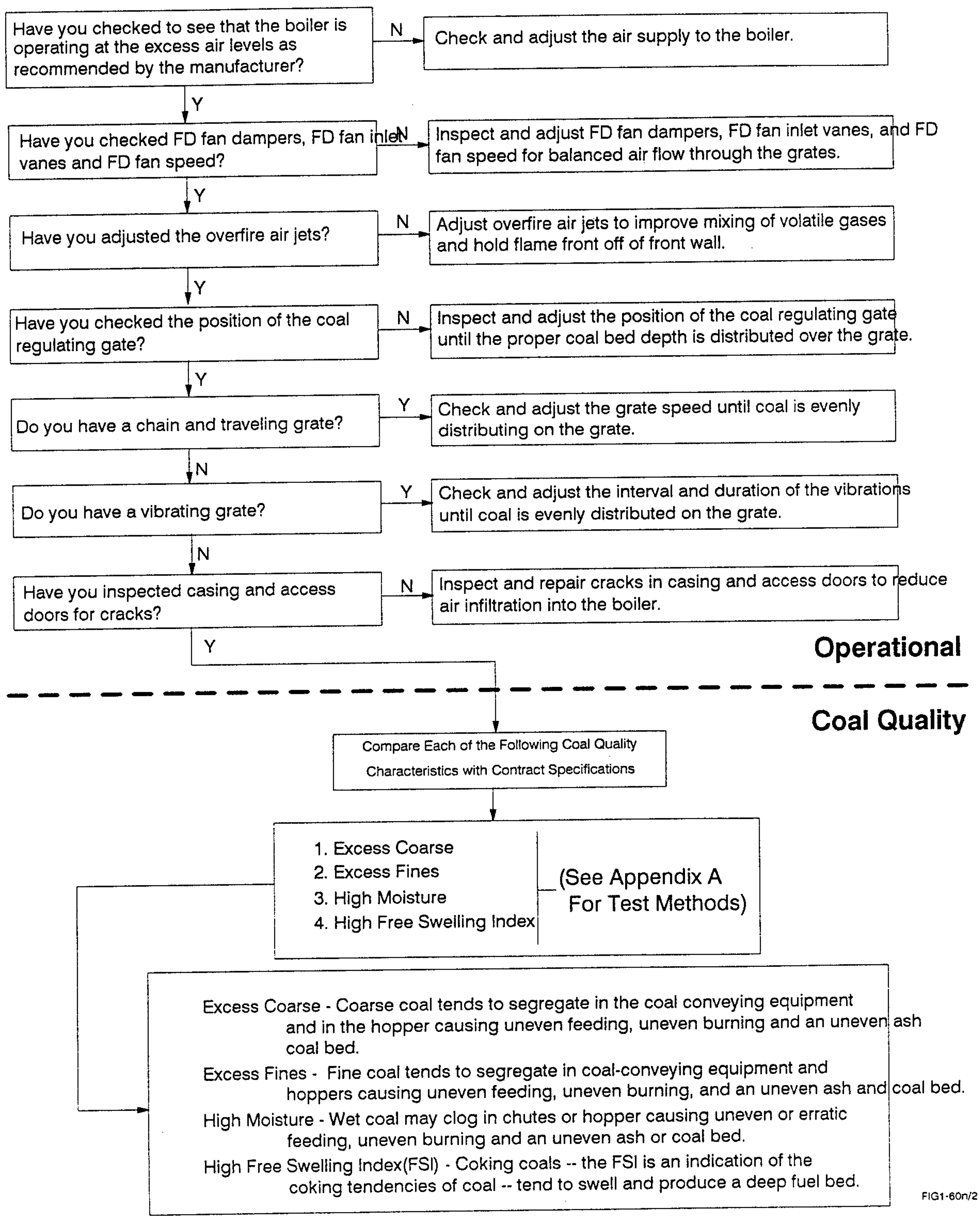


FIG1-60n/2

FIGURE 1-61: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Warped, Burnt, and Cracked Grates
(Chain And Traveling Grate Or Vibrating Grate)

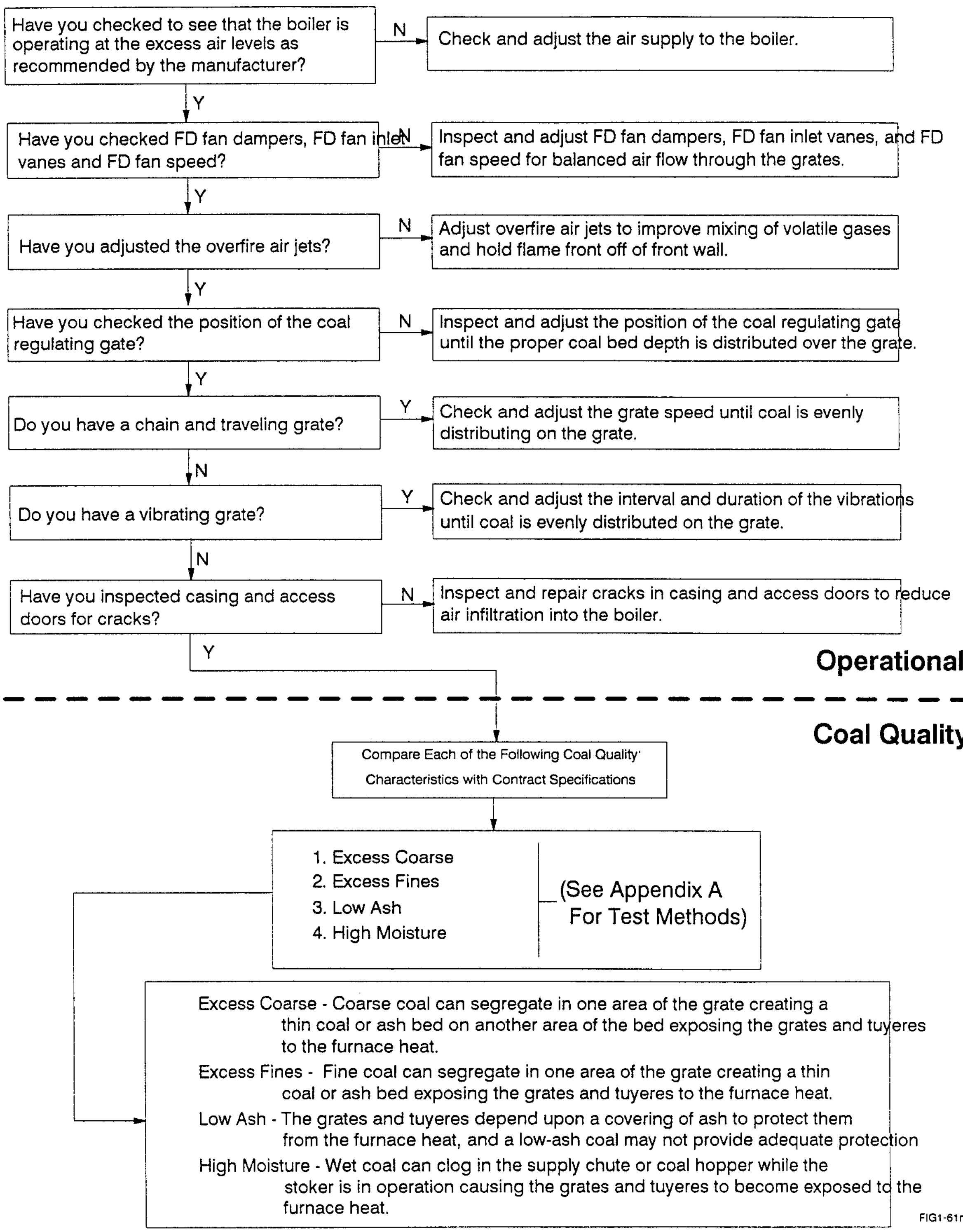


FIG1-61n/2

FIGURE 1-62: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers On The Grates

(Chain And Traveling Grate Or Vibrating Grate)

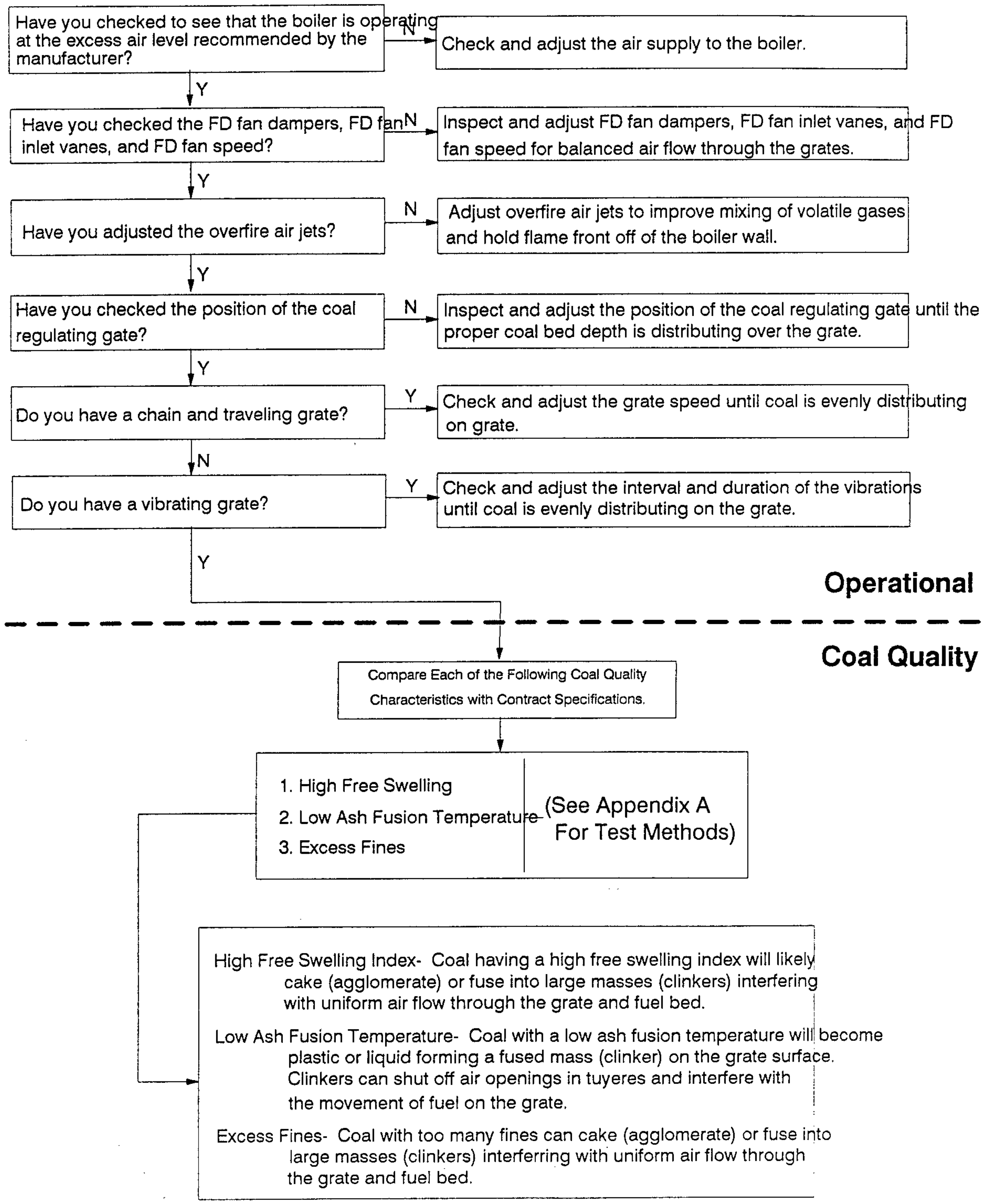


FIG1-62N/2

FIGURE 1-63: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout On The Grate

(Chain And Traveling Grate Or Vibrating Grate)

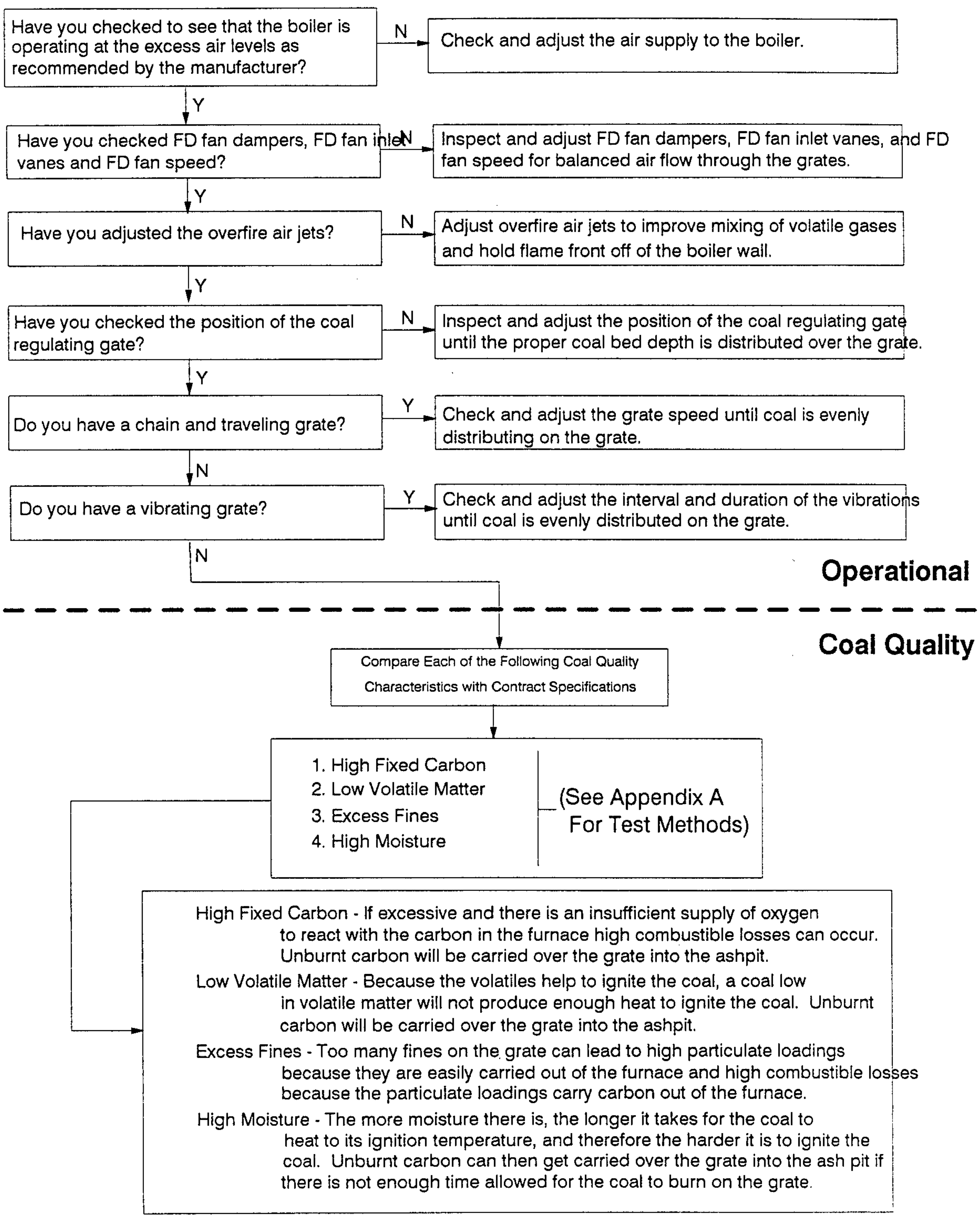


FIG1-63/2

FIGURE 1-64: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Refractory Surfaces

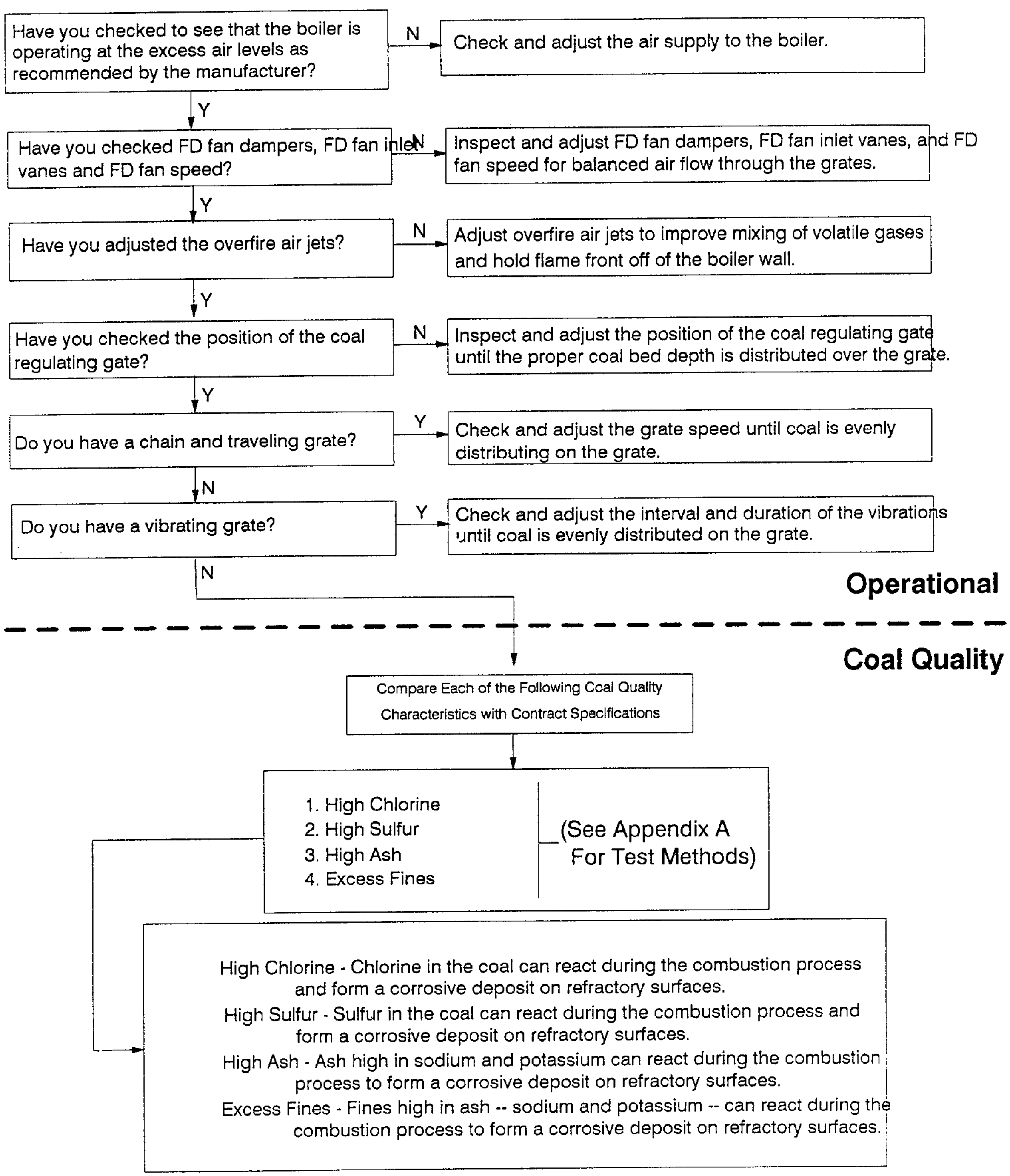
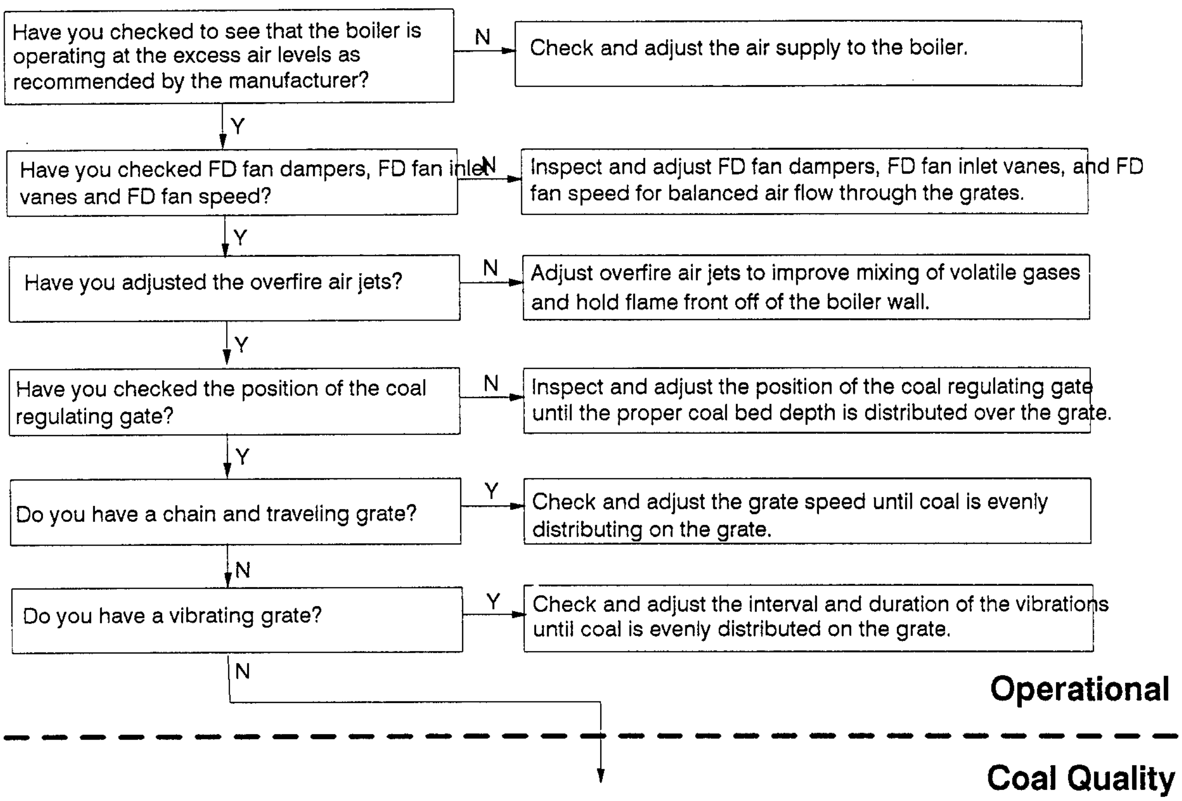


FIG1-64n/2

FIGURE 1-65: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Refractory Surfaces



See next page for Coal Quality Section

FIG1-65n/2

FIGURE 1-65 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of Refractory Surfaces

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on refractory surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away the surface.

FIG1-65nb/2

FIGURE 1-66: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Refractory Surfaces

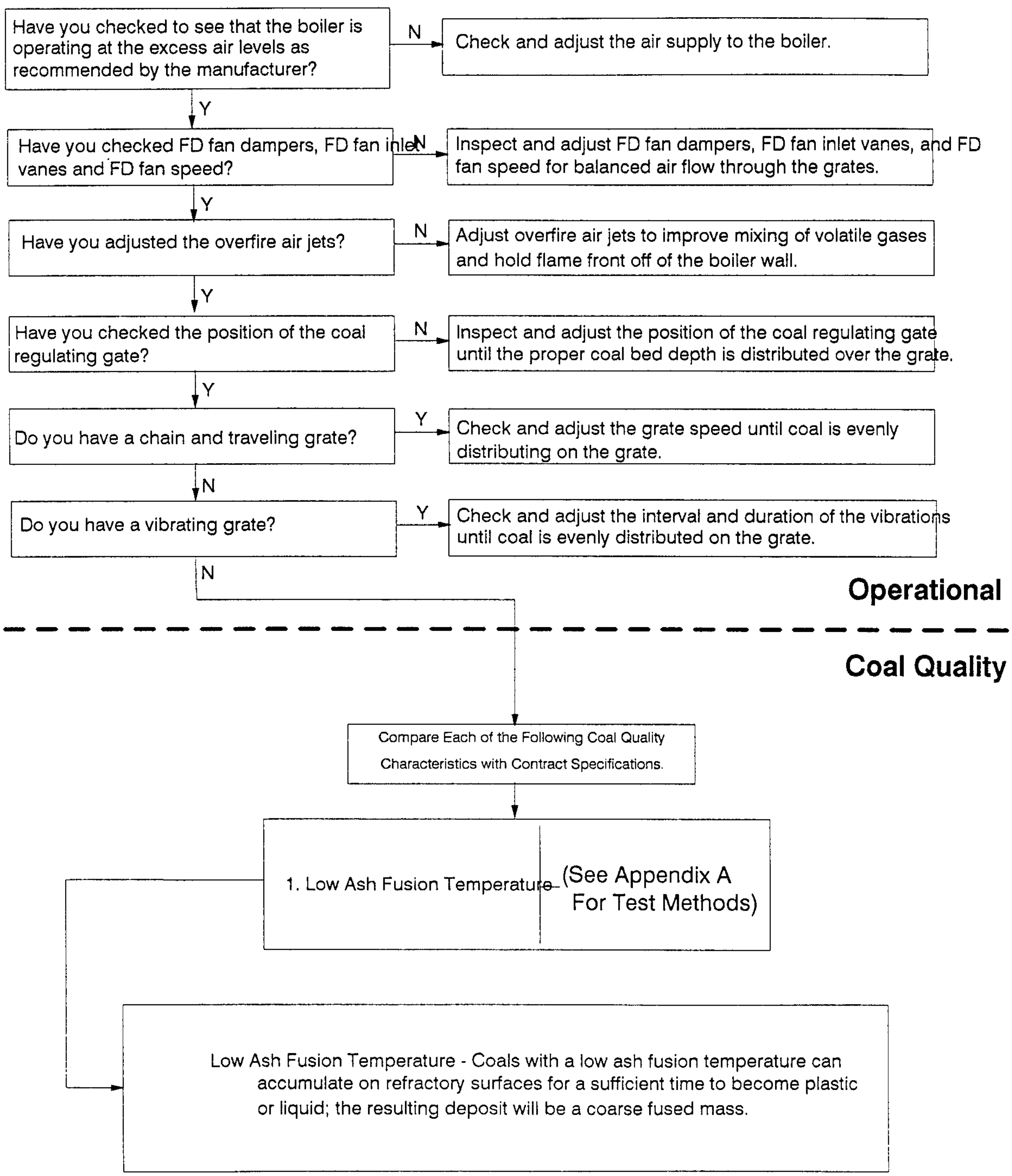


FIG1-66n/2

FIGURE 1-67: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

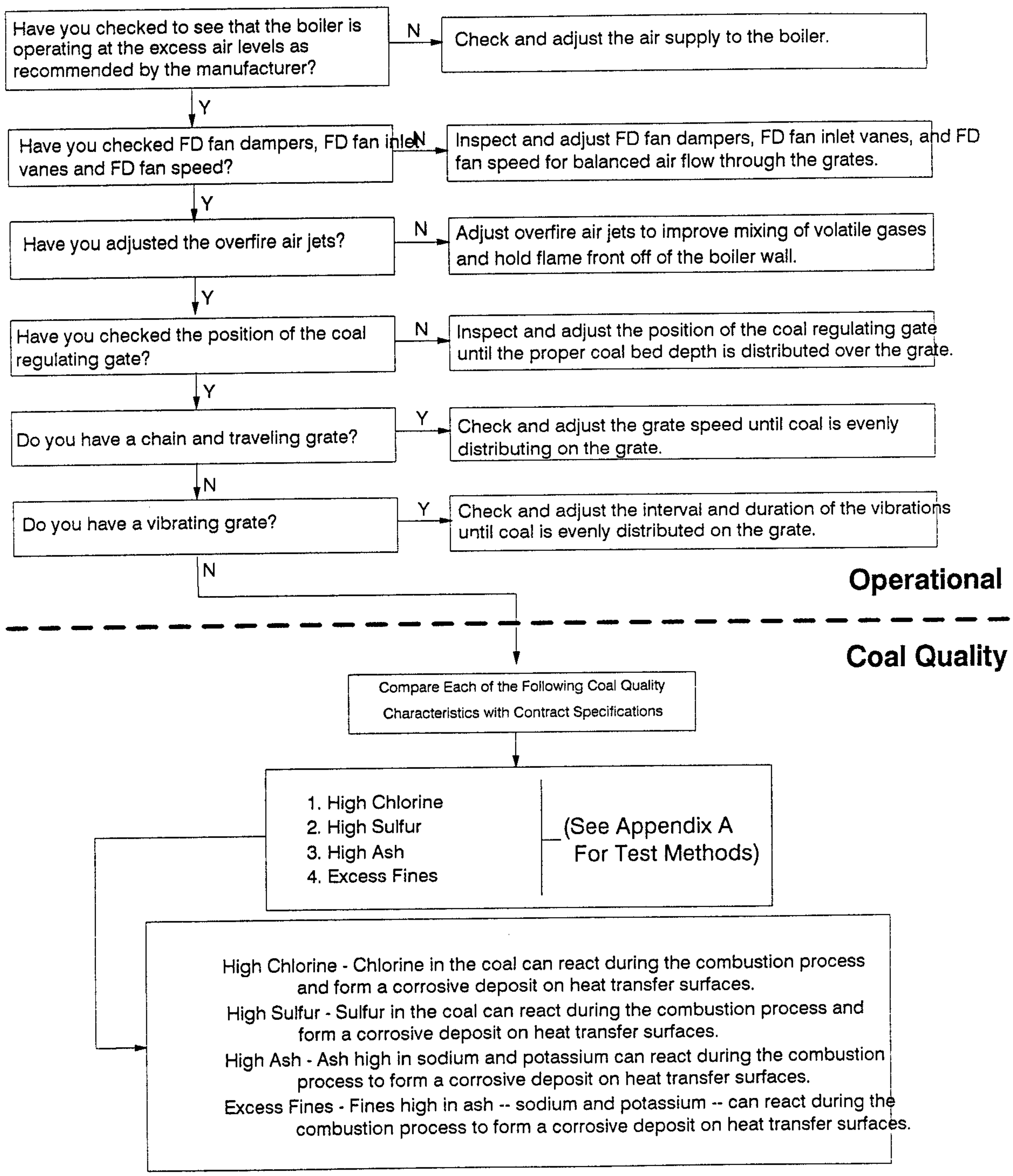
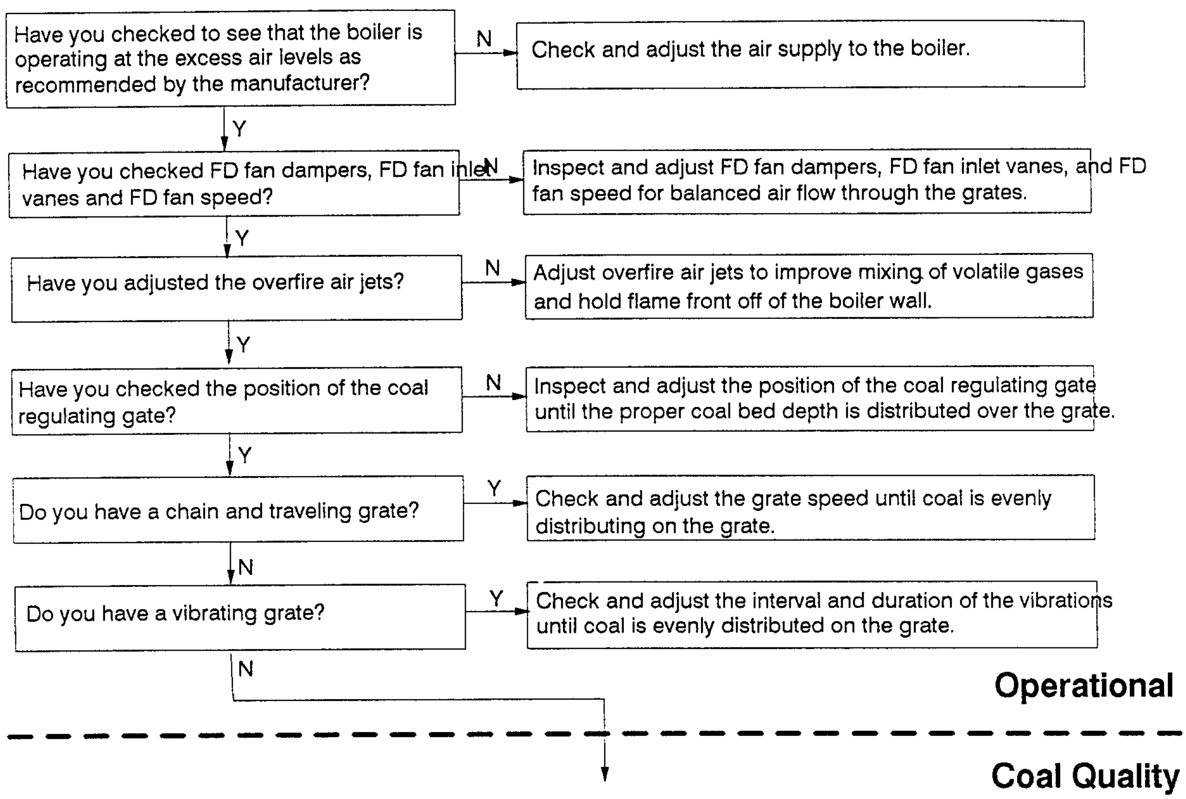


FIG1-67n/2

FIGURE 1-68: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Heat Transfer Surfaces

(Boiler Tubes and Water Walls)



See next page for Coal Quality Section

FIG1-68n/2

FIGURE 1-68 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on heat transfer surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away the surface.

FIG1-68nb/2

FIGURE 1-69: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Boiler Tubes and Water Walls)

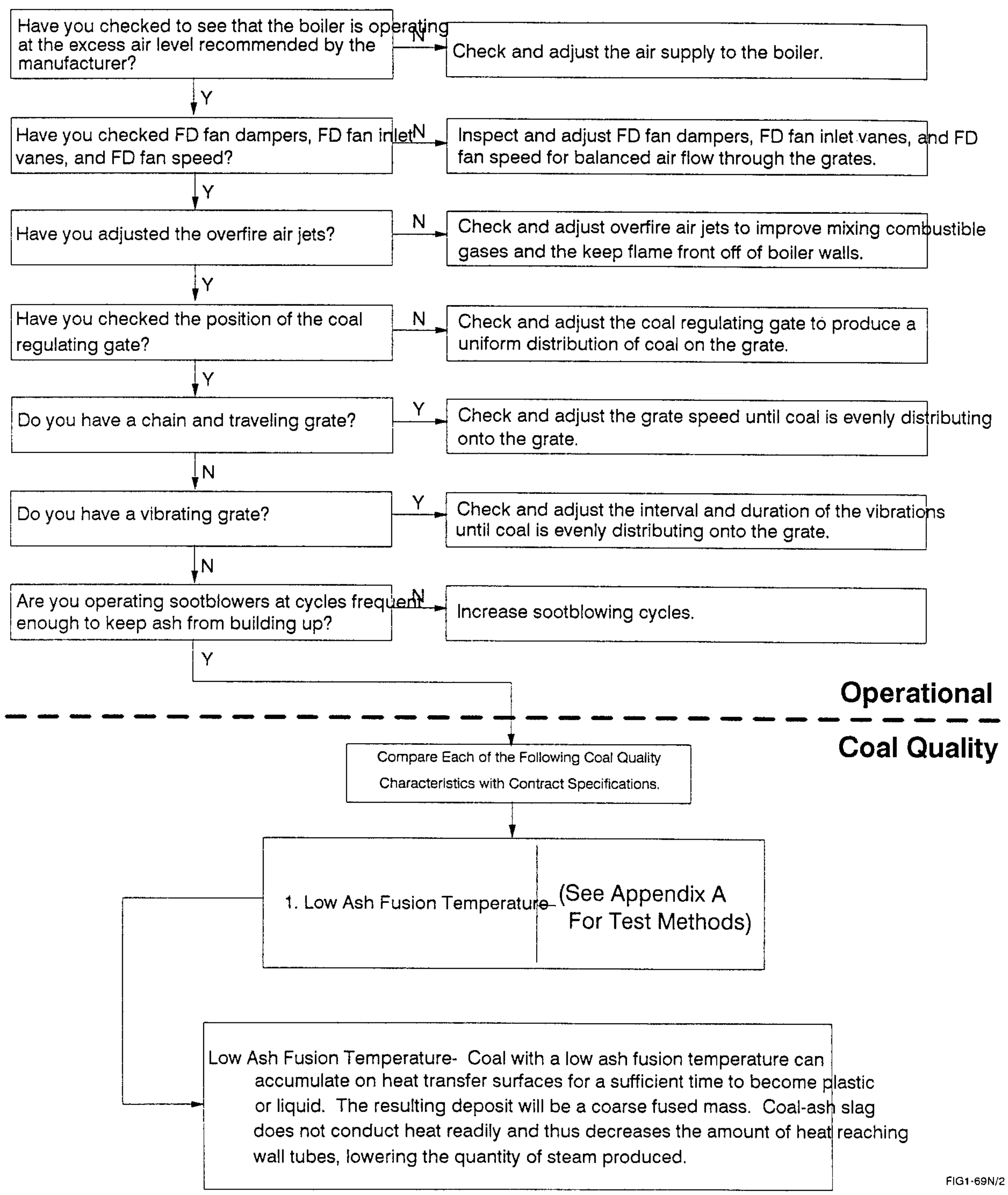


FIGURE 1-70: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

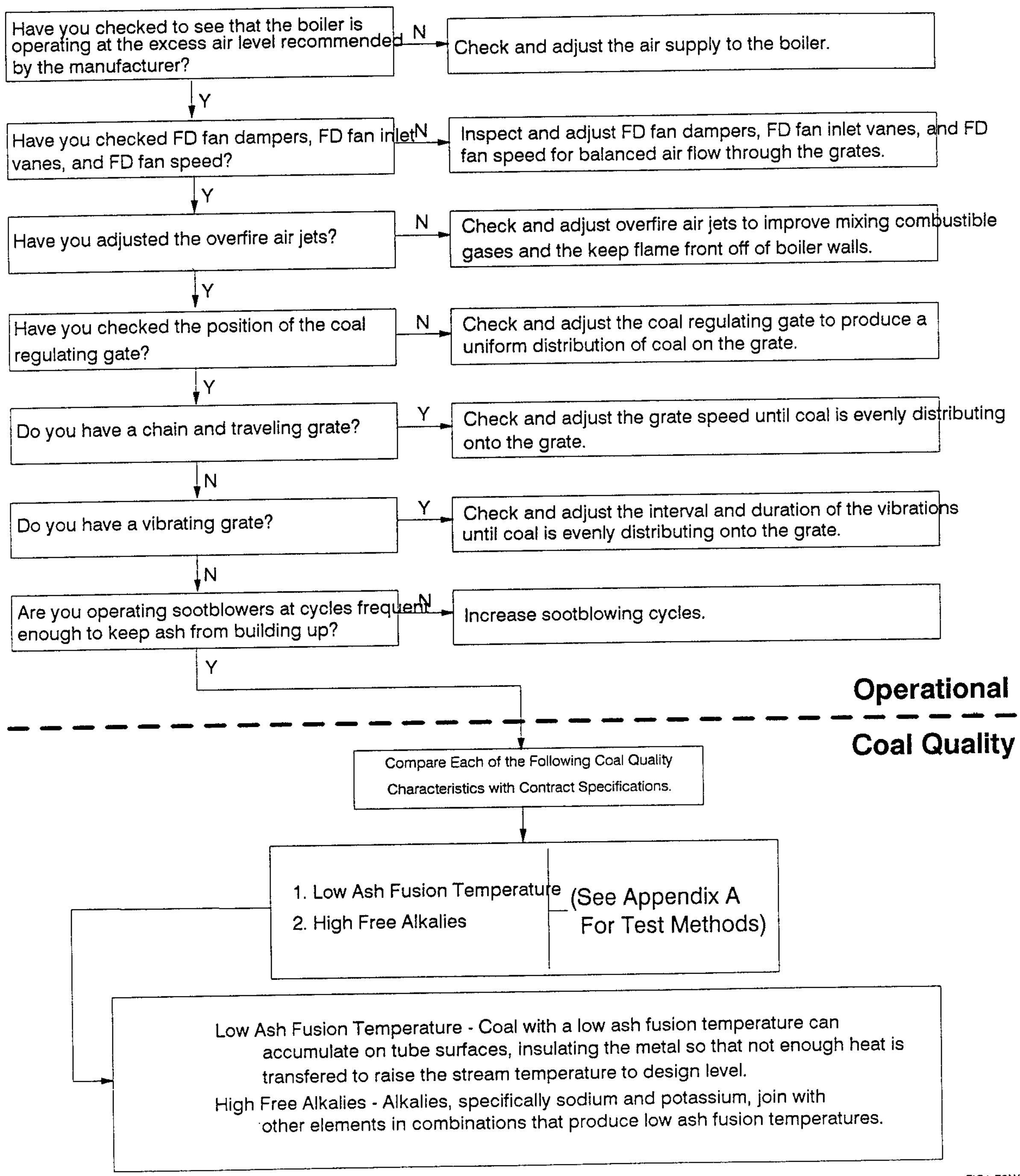


FIG1-70N/2

FIGURE 1-71: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Baffles

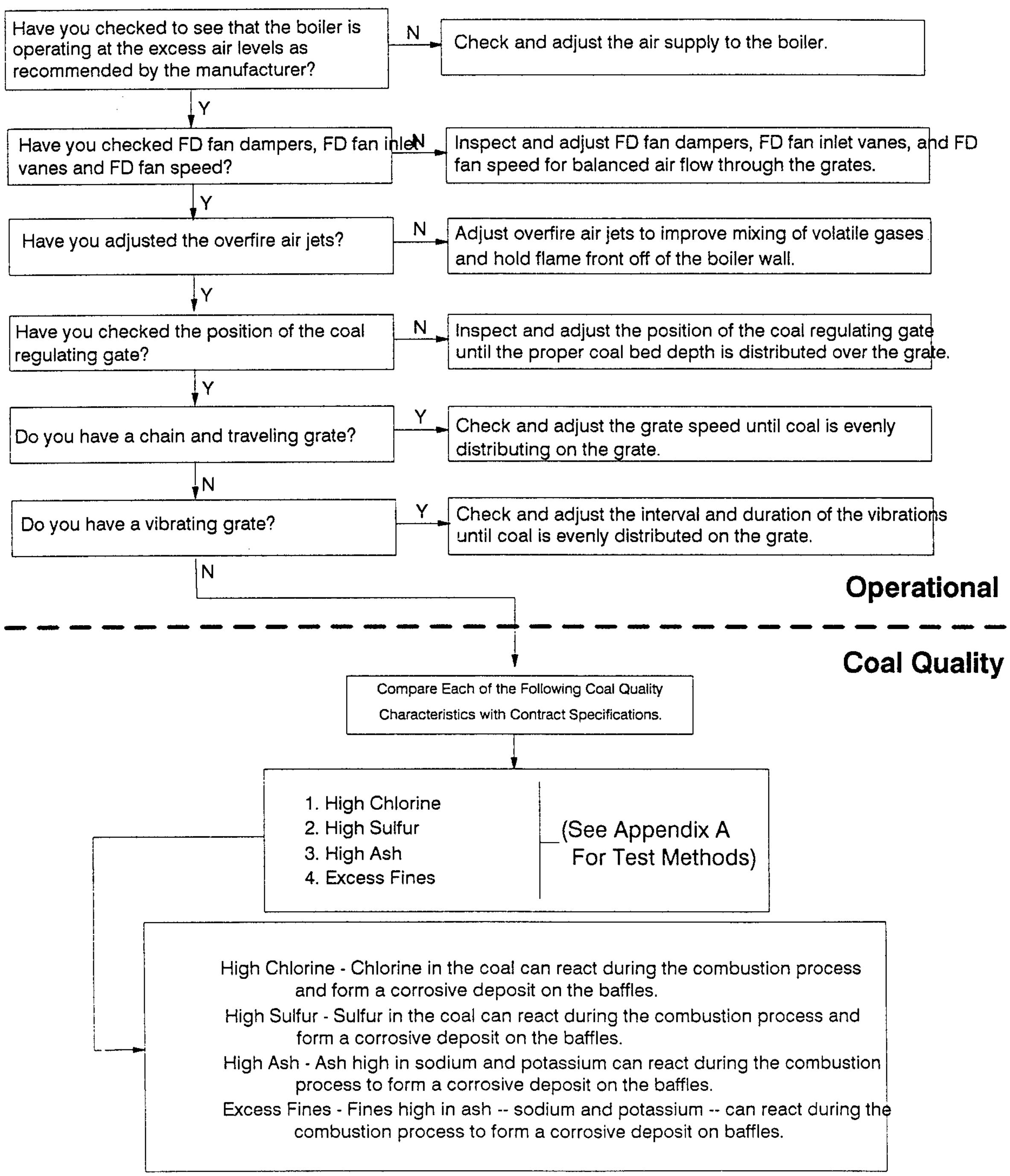
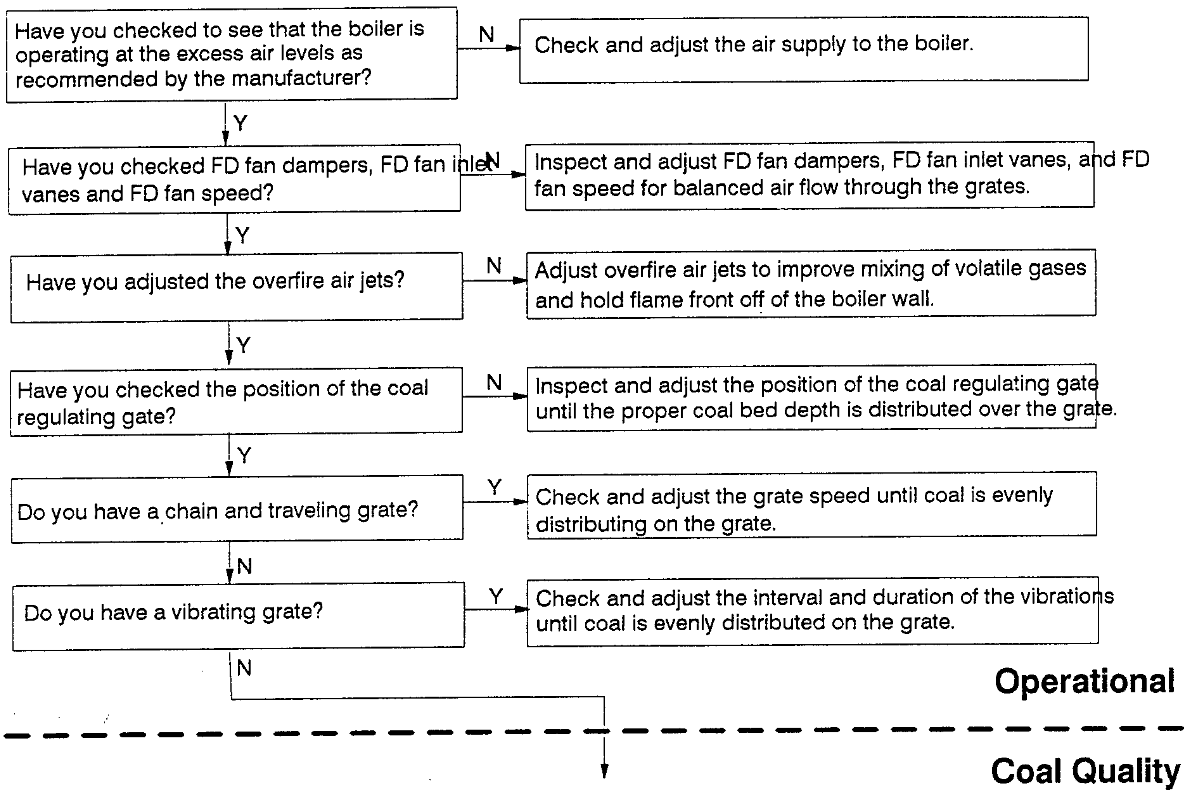


FIG1-71n/3

FIGURE 1-72: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Heat Transfer Surfaces
(Baffles)



See next page for Coal Quality Section

FIG1-72n/2

FIGURE 1-72 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Baffles)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on baffles eventually wearing away the surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the baffles eventually wearing away the surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

FIG1-74nb/2

FIGURE 1-73: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Baffles)

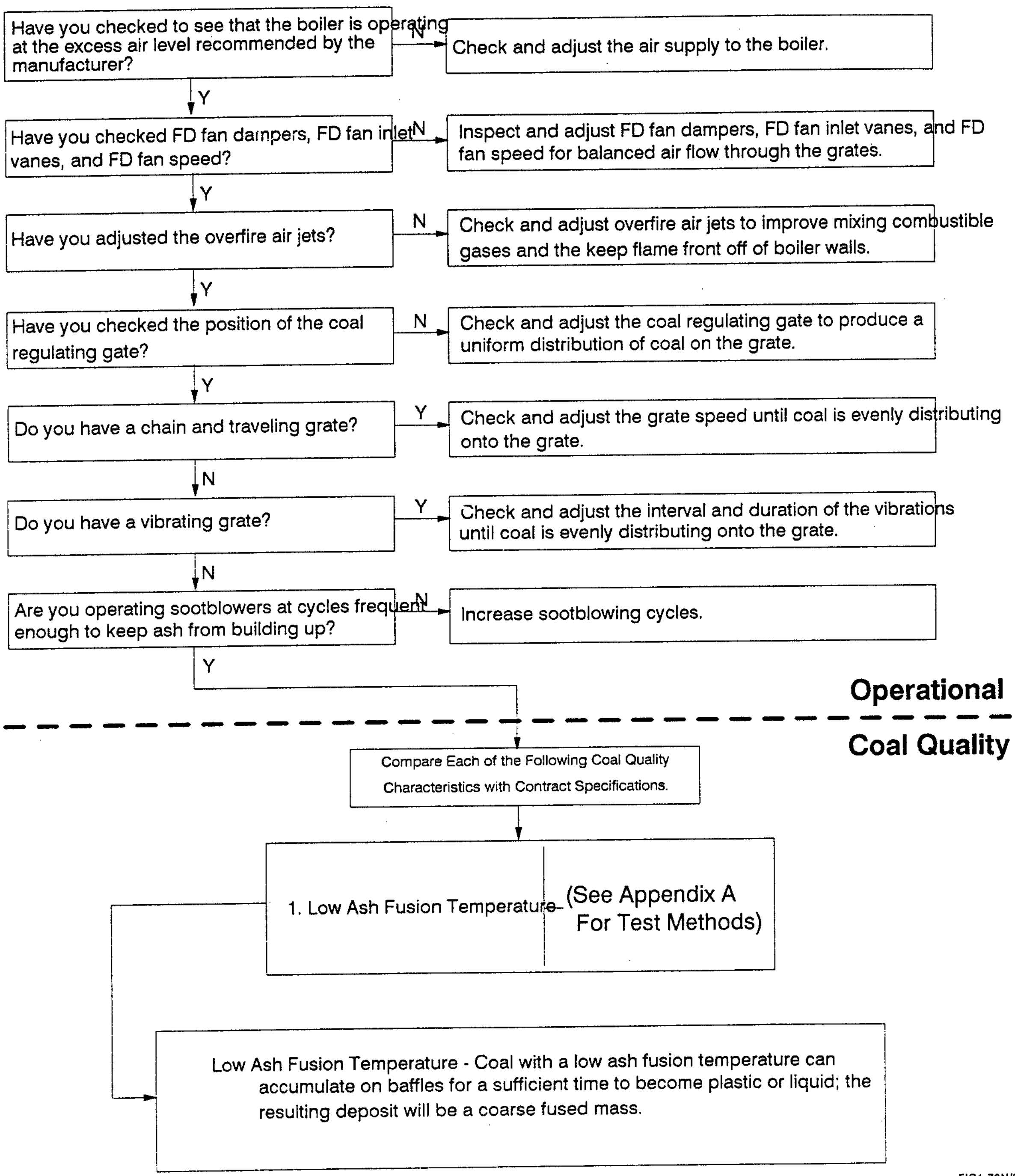


FIG1-73N/2

FIGURE 1-74: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Baffles)

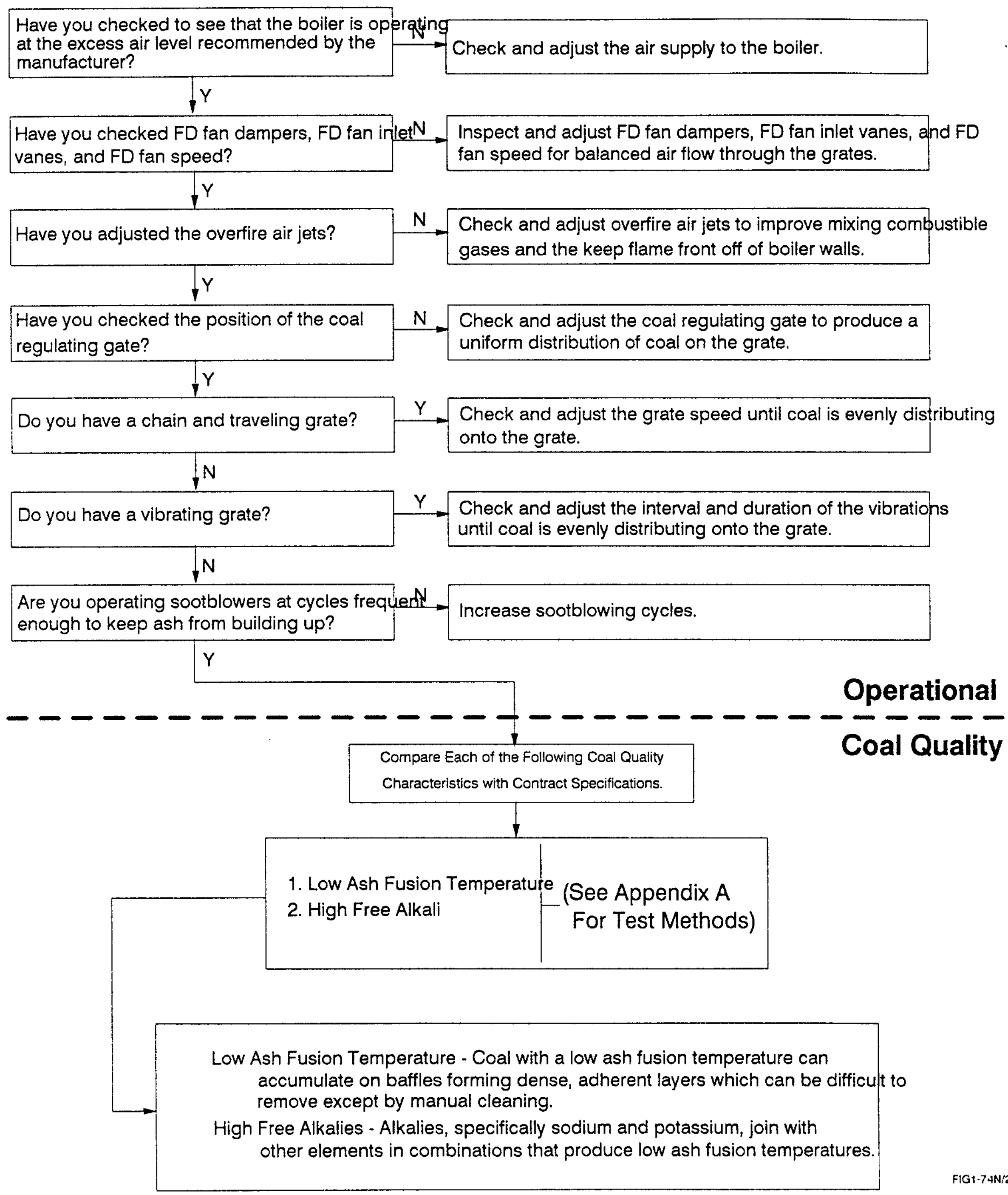


FIG1-74N/2

FIGURE 1-75: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Forced Draft Fan)

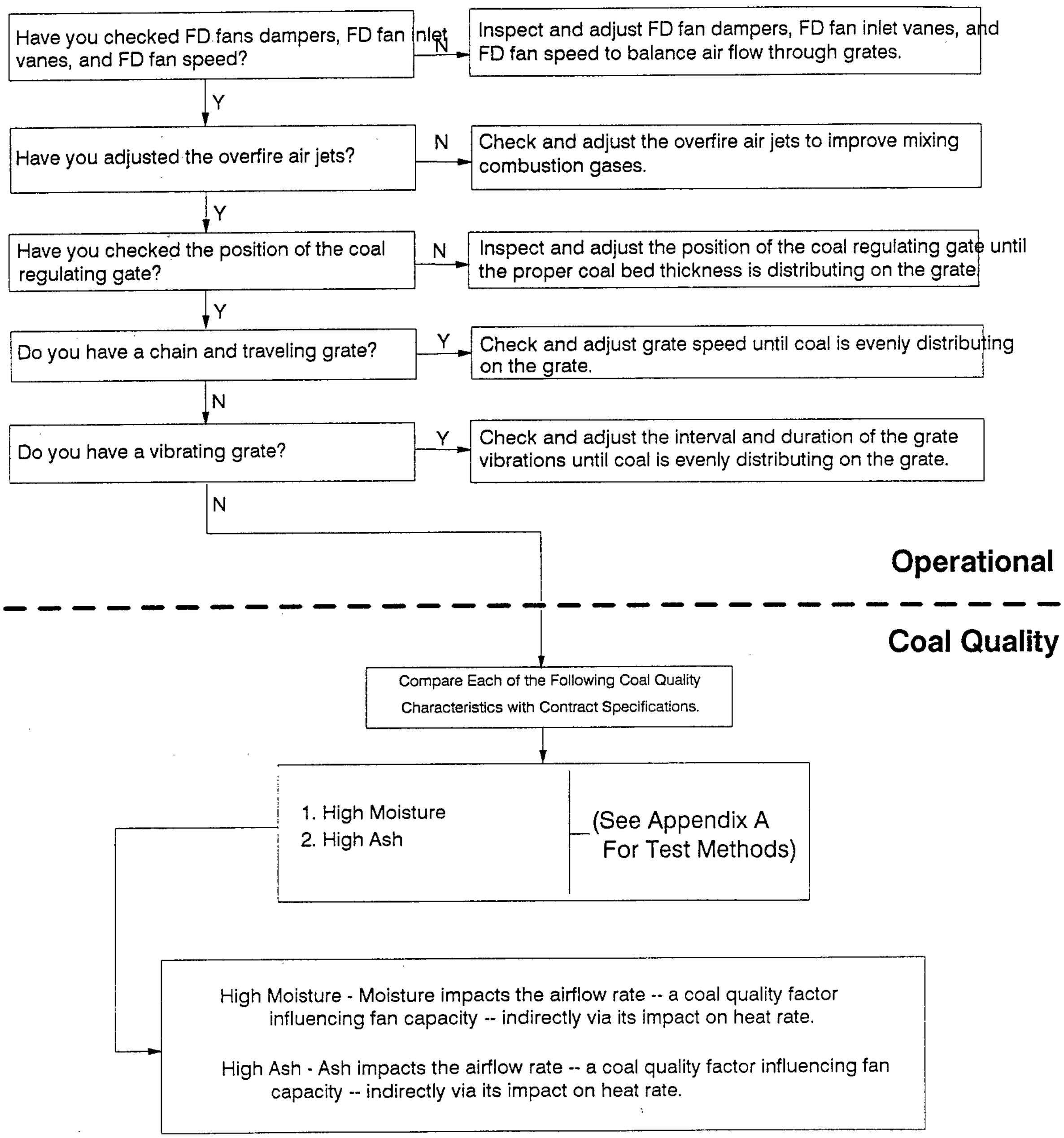


FIG1-75n/3

FIGURE 1-76: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Forced Draft Fan

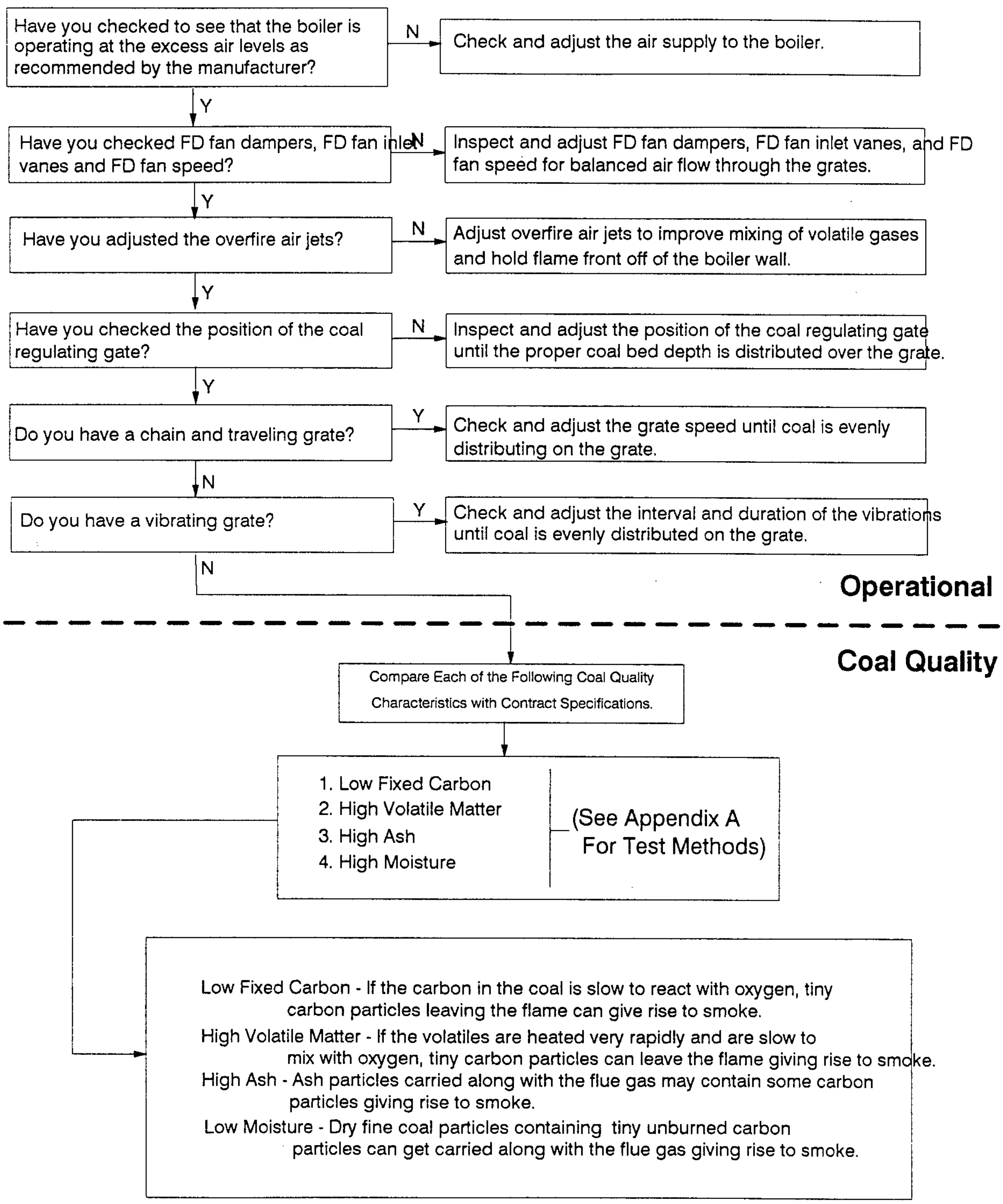


FIG1-76n/3

FIGURE 1-77: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Induced Draft Fan)

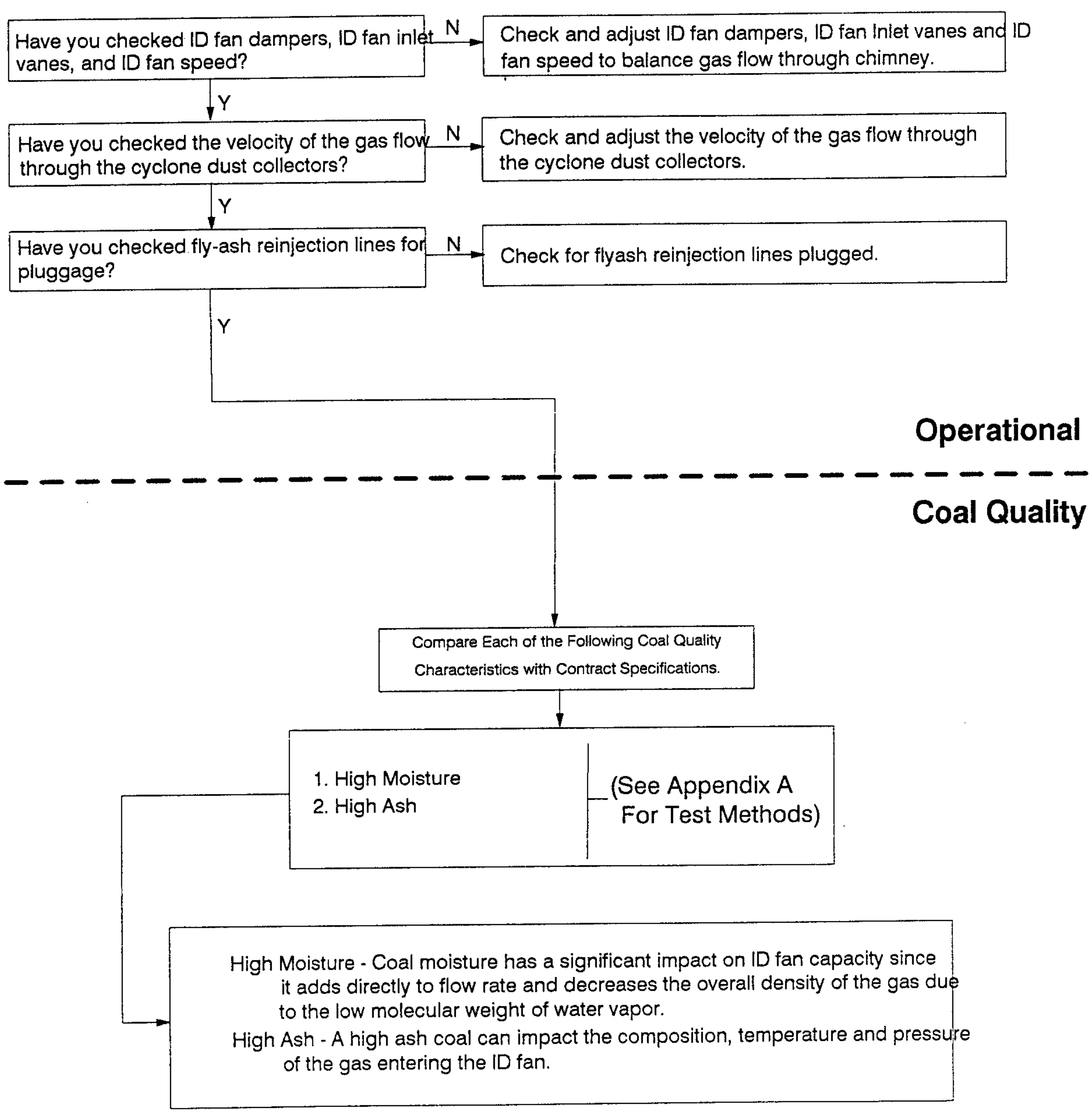


FIG1-77n/3

FIGURE 1-78: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Induced Draft Fan

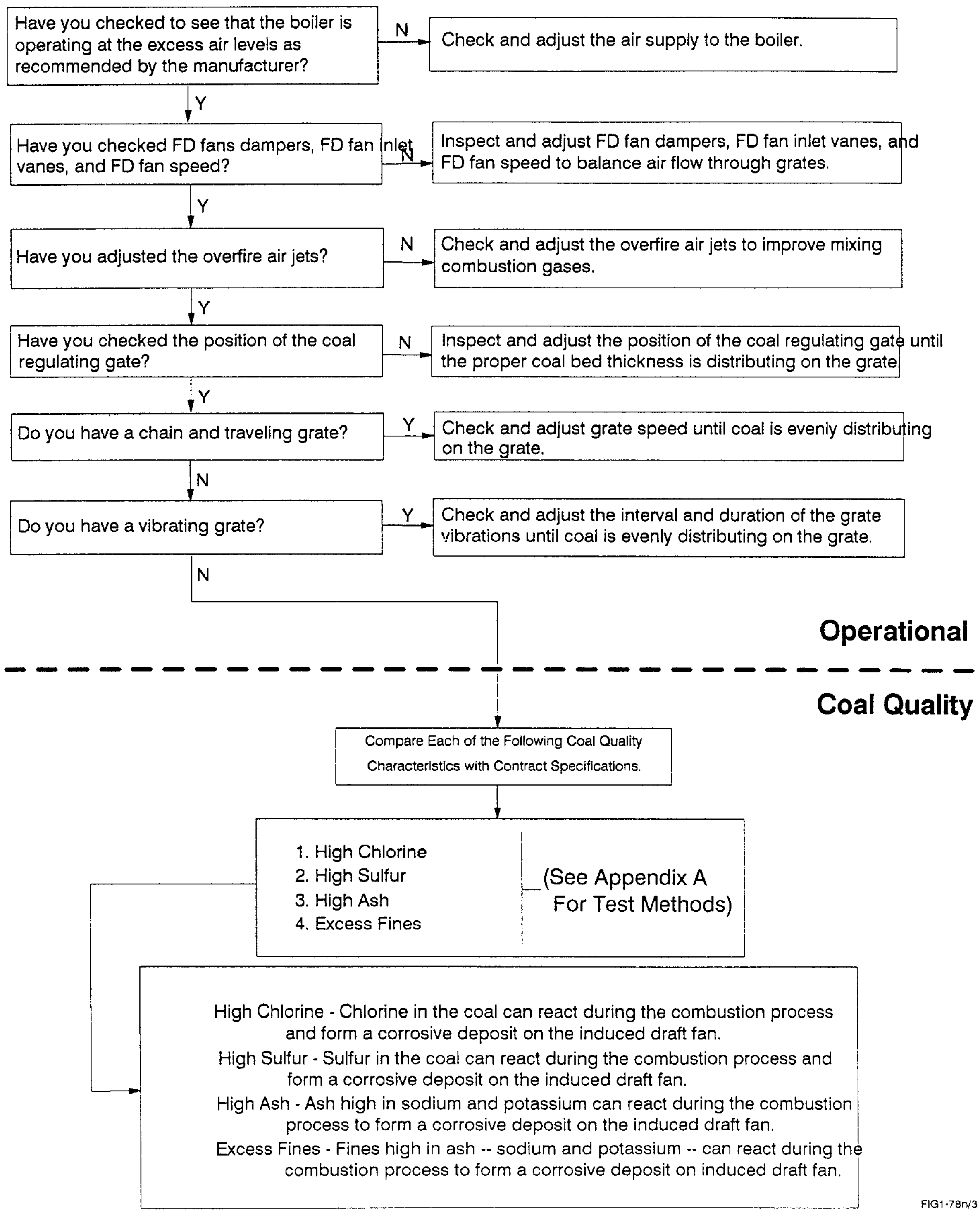
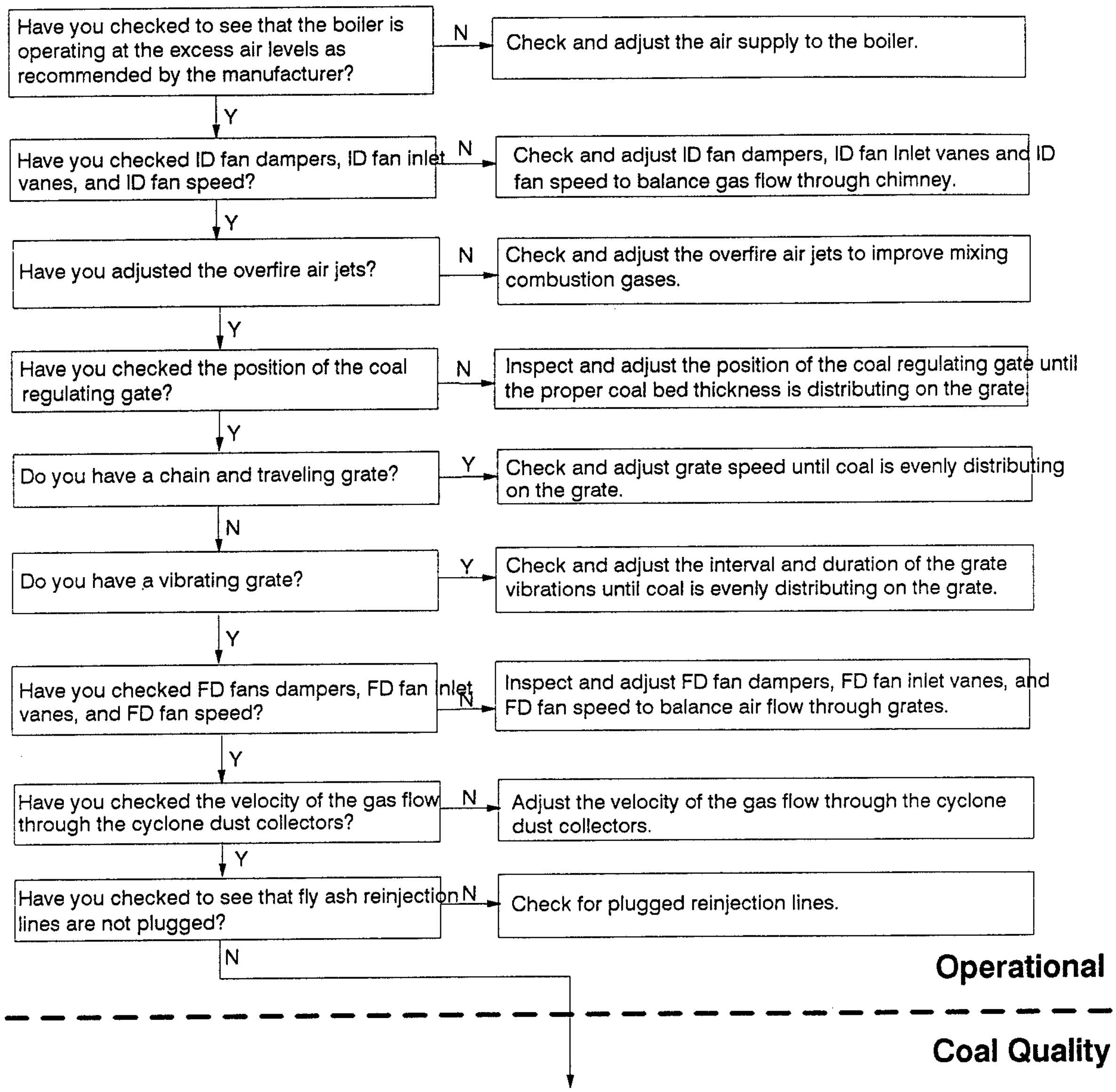


FIGURE 1-79: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan



See next page the Coal Quality Section.

FIG1-79n/3

FIGURE 1-79 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From The Induced Draft Fan

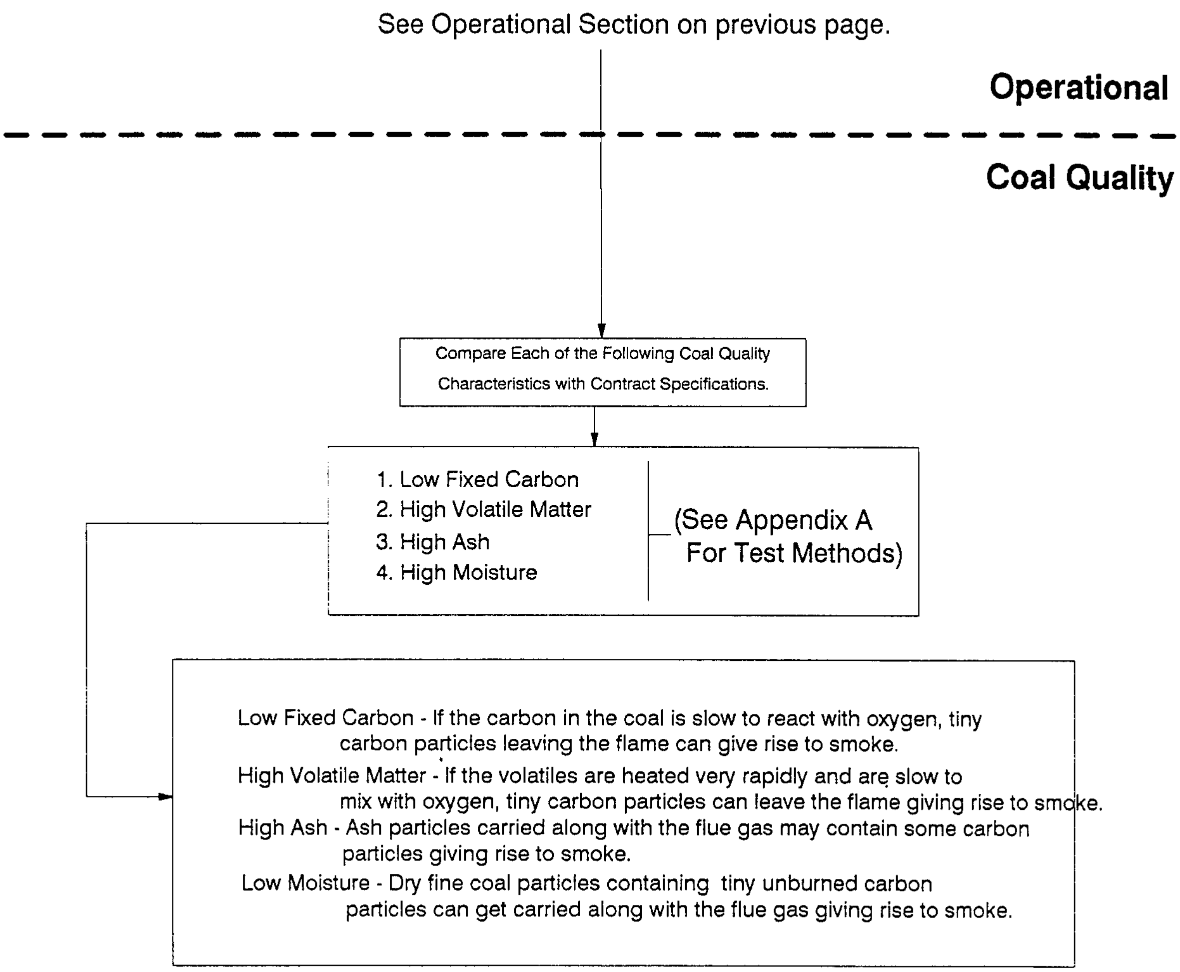
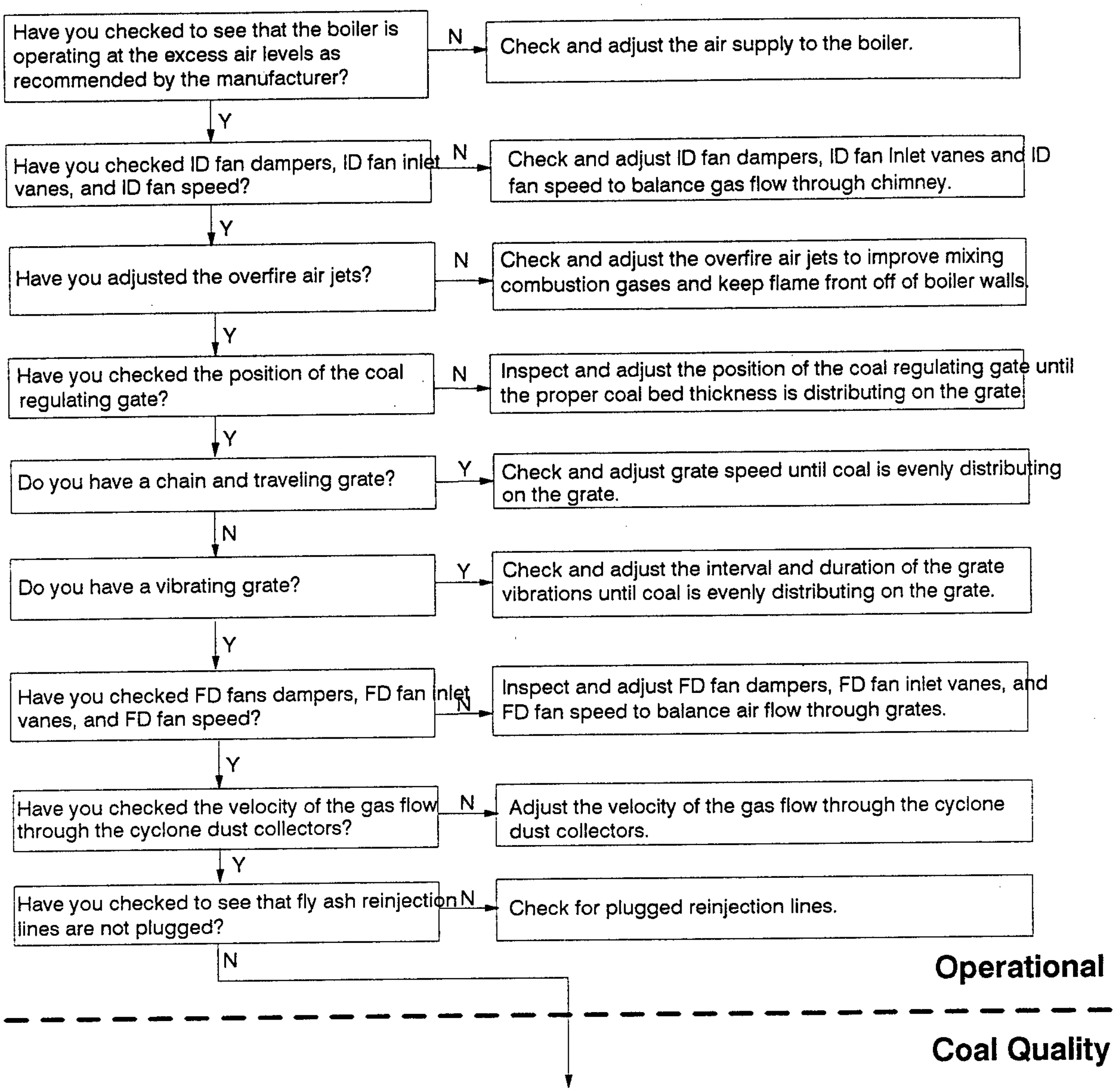


FIG1-79nb/3

FIGURE 1-80: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Induced Draft Fan



See next page the Coal Quality Section.

FIG1-80n/3

FIGURE 1-80 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

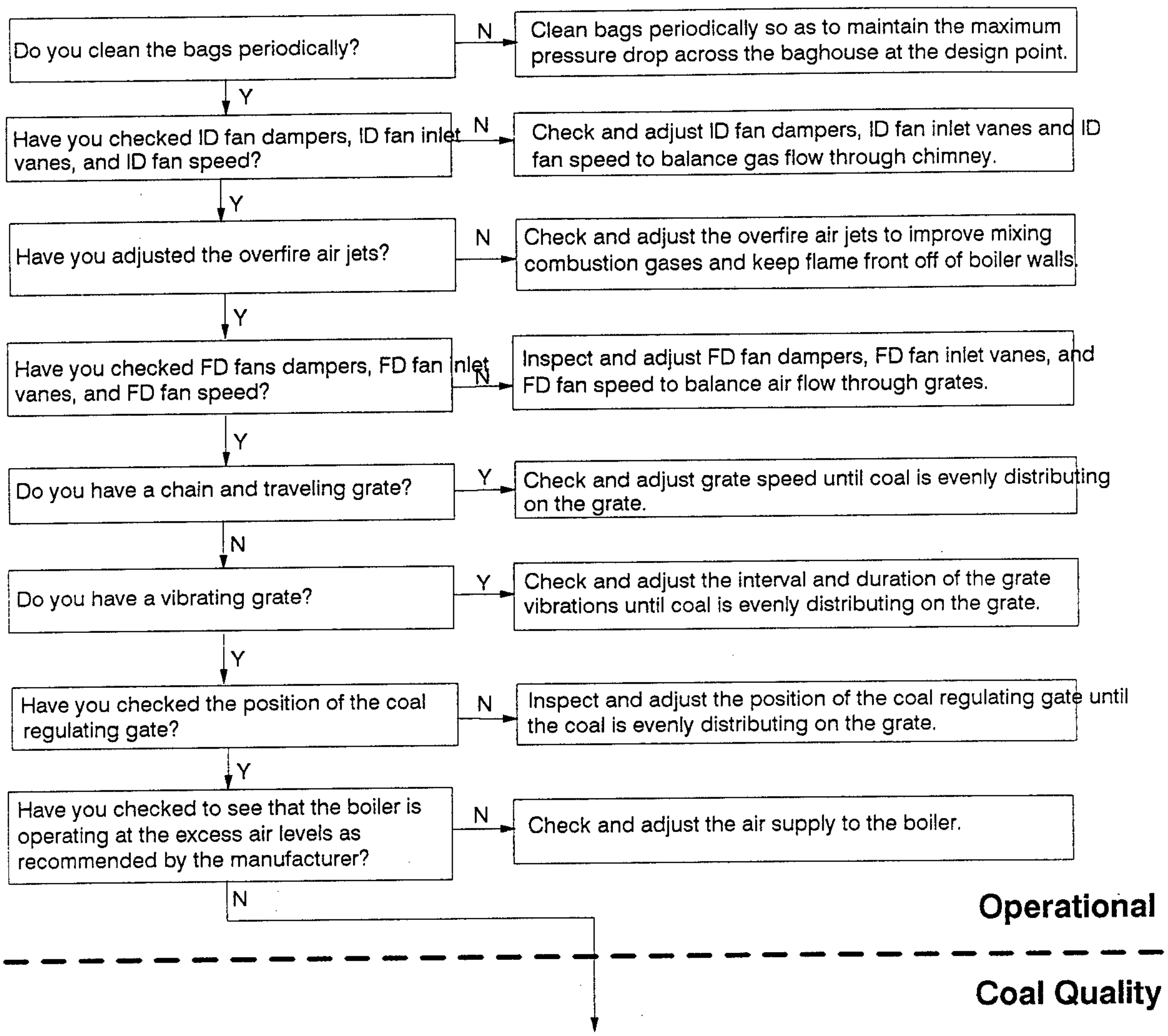
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG1-8Onb/3

FIGURE 1-81: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Baghouse)



See next page the Coal Quality Section.

FIG1-81n/3

FIGURE 1-81 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout From The Particulate Removal System (Baghouse)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG1-81nb/3

FIGURE 1-82: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Baghouse)

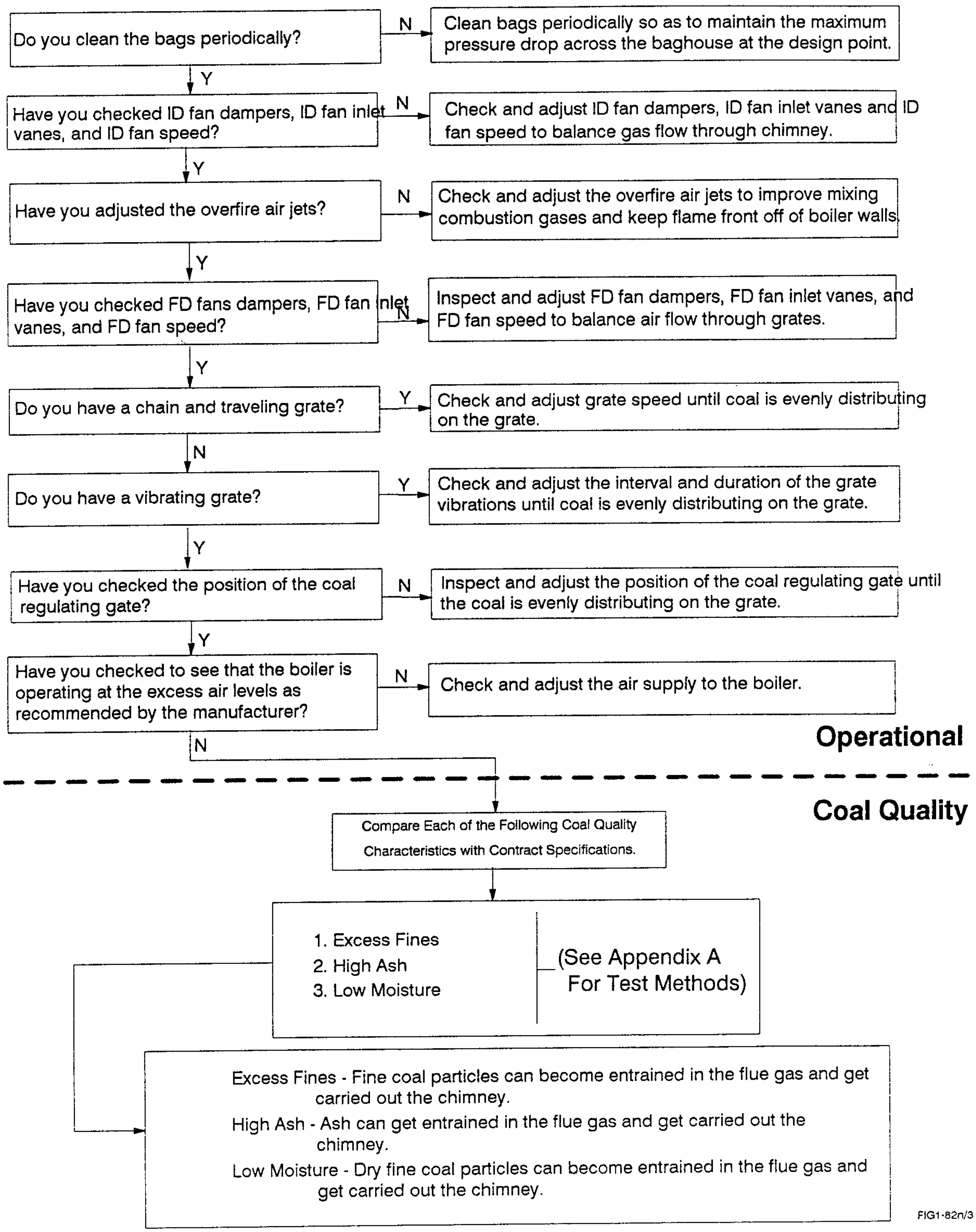
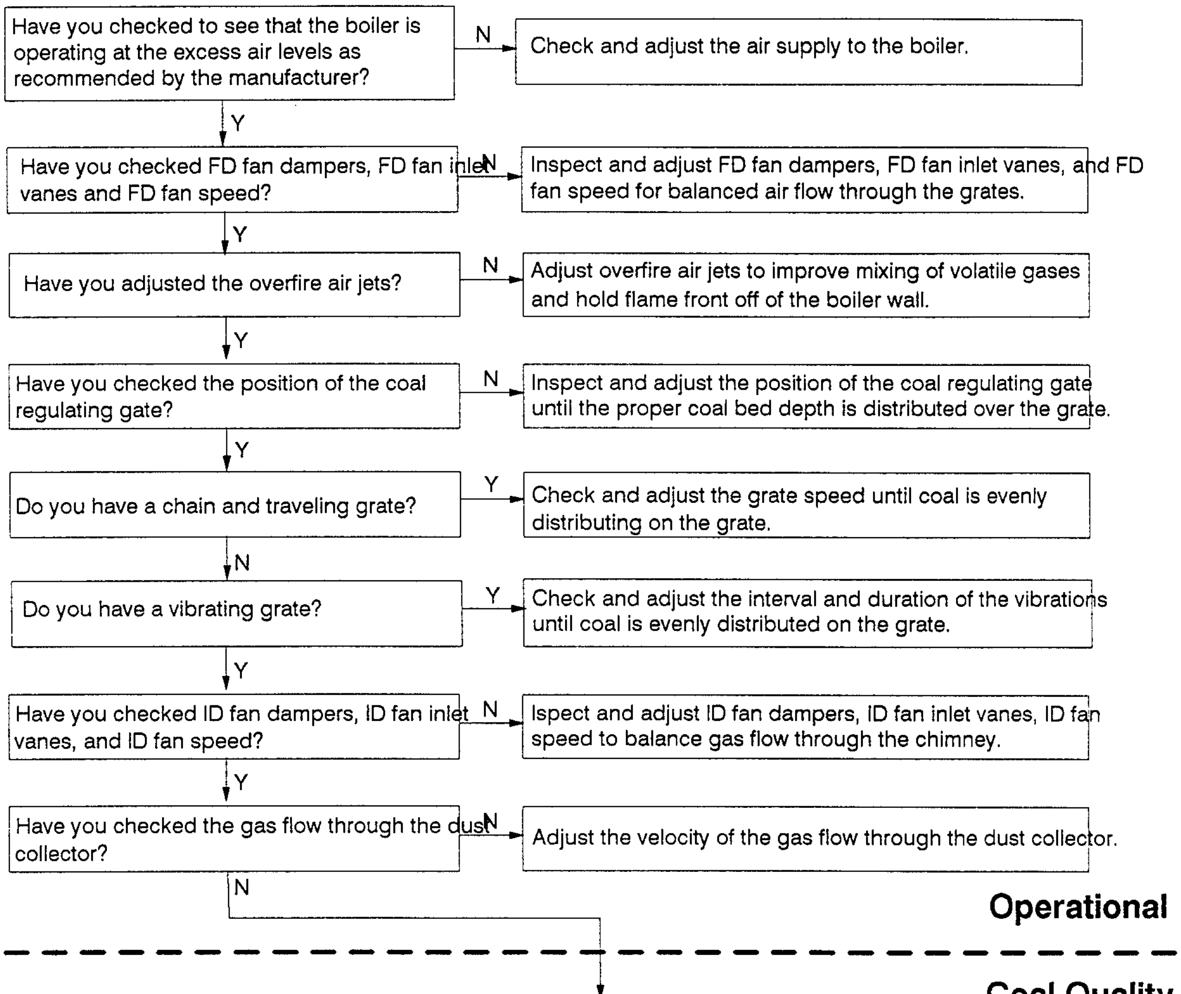


FIG1-82n/3

FIGURE 1-83: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System (Cyclones)



See next page for Coal Quality Section

FIG1-83n/3

FIGURE 1-83 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System (Cyclones)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

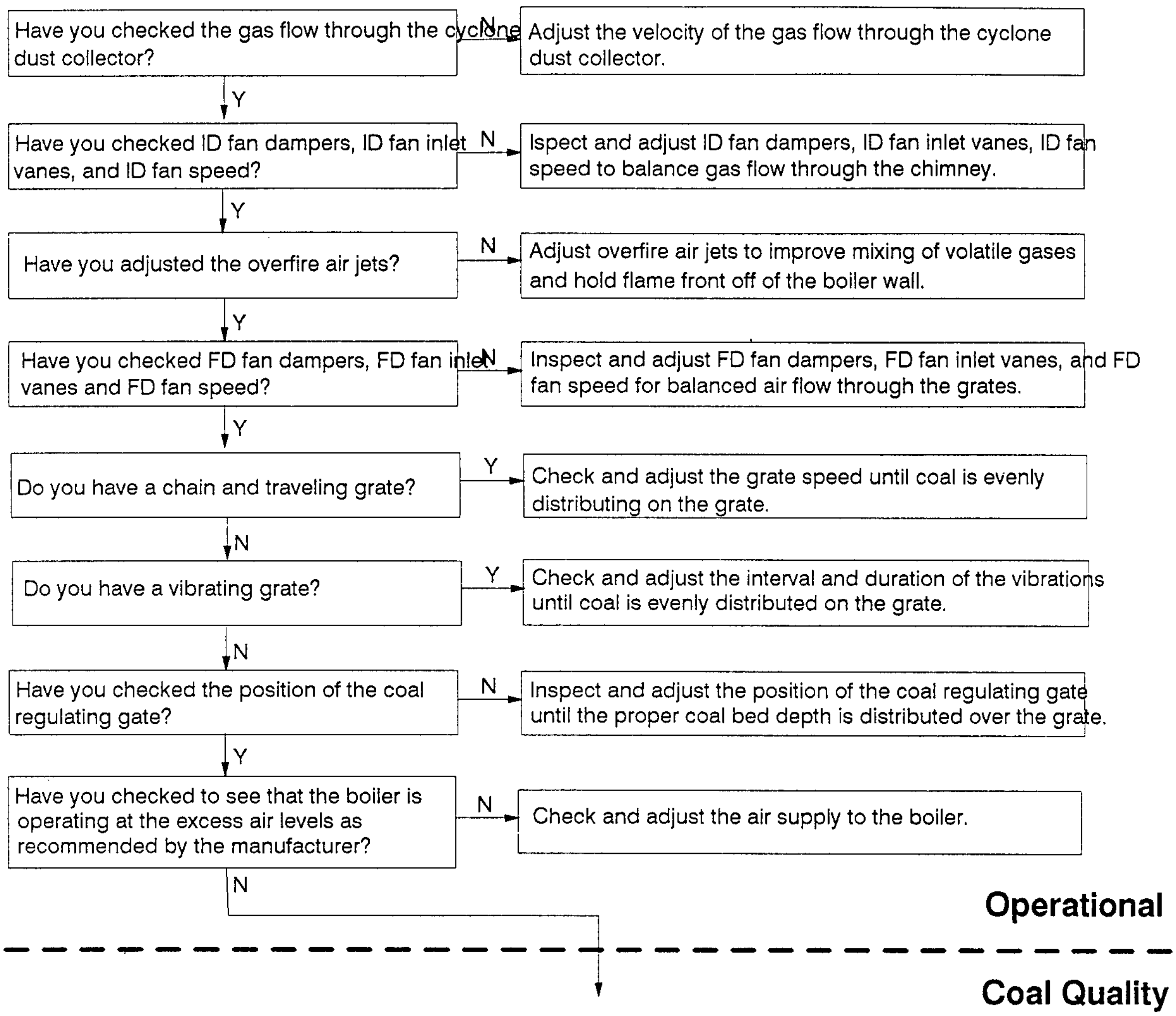
High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG1-83nb/3

FIGURE 1-84: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion In The Particulate Removal System

(Cyclones)



See next page for Coal Quality Section

FIG1-84n/3

FIGURE 1-84 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion In The Particulate Removal System
(Cyclones)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG1-84nb/3

FIGURE 1-85: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Cyclones)

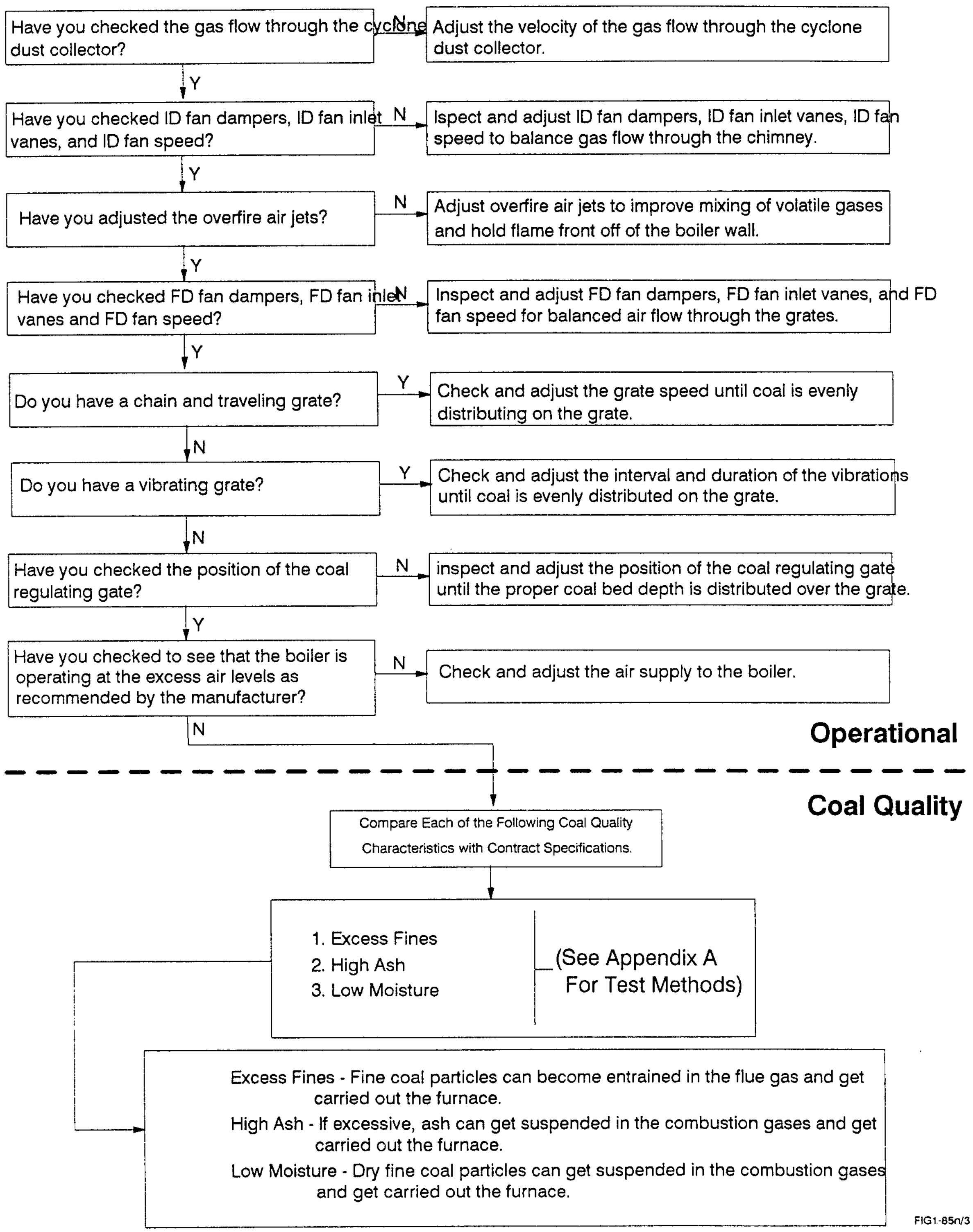
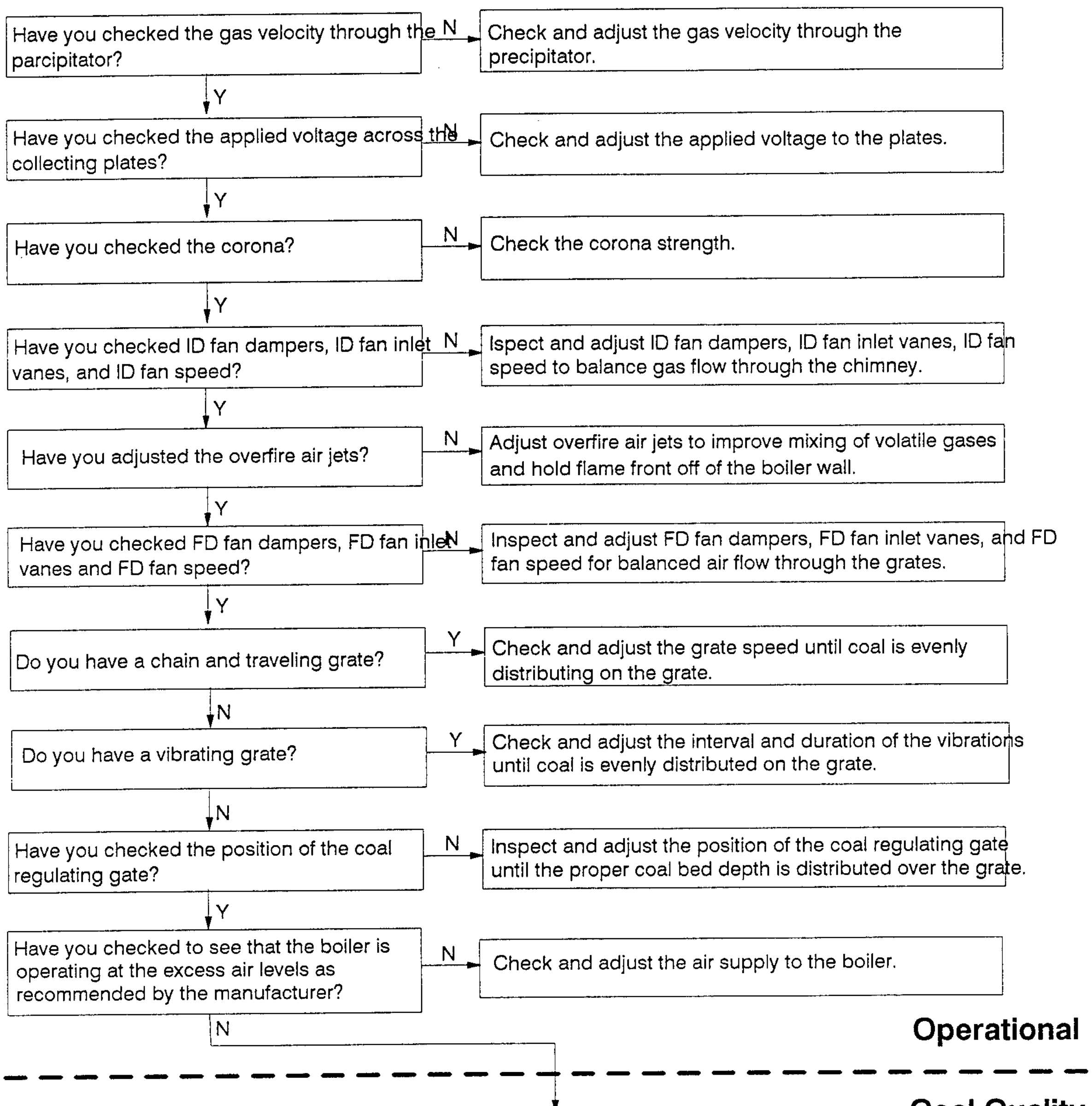


FIG1-85n/3

FIGURE 1-86: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG1-86n/3

FIGURE 1-86 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

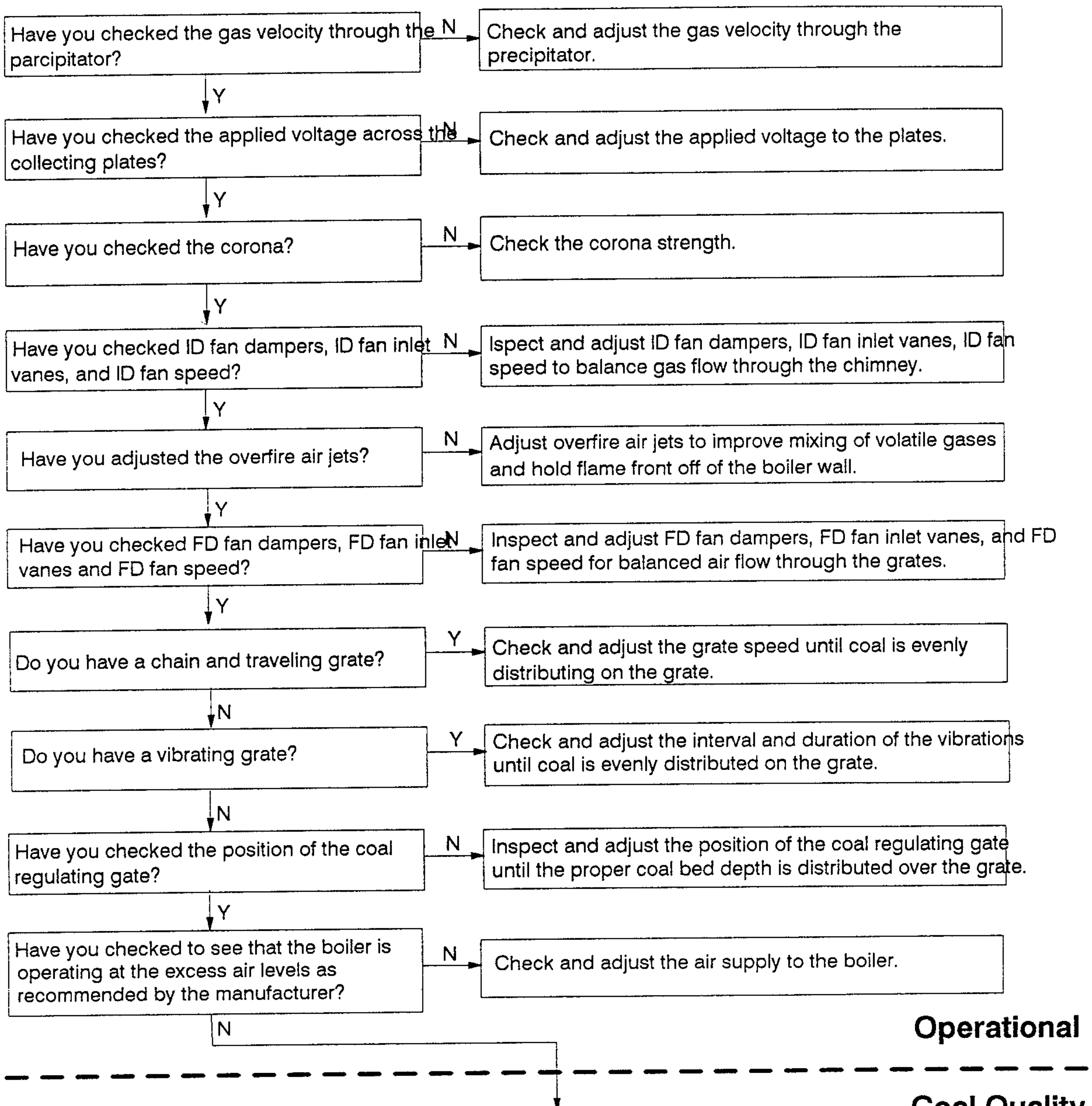
High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG1-86nb/3

FIGURE 1-87: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System

(Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG1-87n/3

FIGURE 1-87 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with eventually wearing away the metal surface.

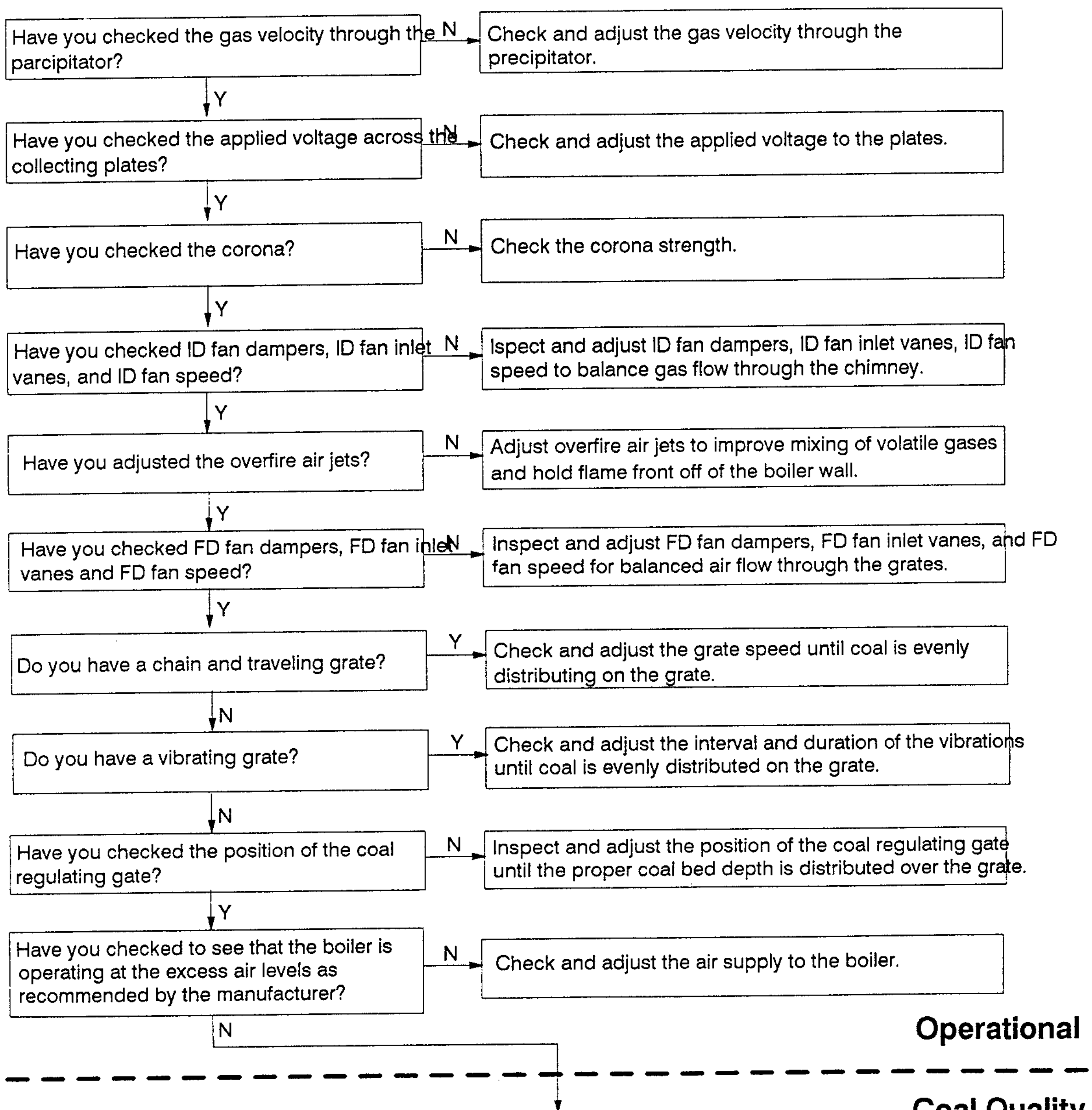
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with and eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with and wear away metal surfaces.

FIG1-87nb/3

FIGURE 1-88: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG1-88r/3

FIGURE 1-88: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)

See previous page for Operational Section.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Fly Ash Resistivity
2. High Ash
3. Low Sulfur
4. Excess Fines
5. Low Moisture

(See Appendix A For Test Methods)

Fly Ash Resistivity - The resistivity of the fly ash is the key parameter which limits the applied voltage and hence the collection efficiency for a given precipitator design and operating configuration.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace. A high calcium content in the ash reduces the effective sulfur trioxide concentration, thereby decreasing precipitator performance. Sulfur trioxide is important in the resistivity mechanism because water molecules in combination with sulfur trioxide are absorbed on the surface of the ash particles and form a conductive film, shich decrease resistivity.

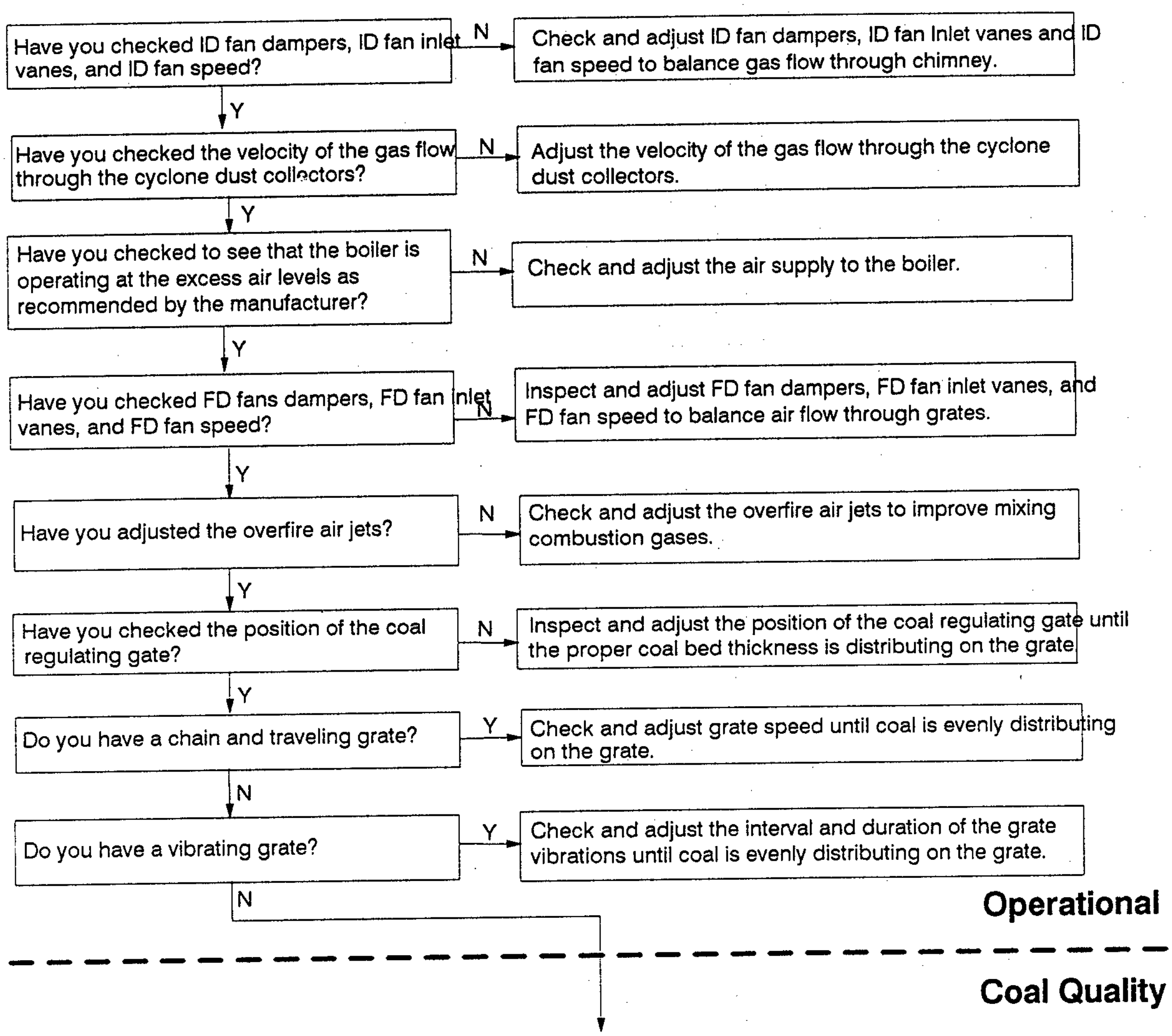
Low Sulfur - Ash from coals low in sulfur is more difficult to precipitate than ash from higher sulfur coals.

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG1-88nb/3

FIGURE 1-89: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Fly-Ash Recycle



See next page the Coal Quality Section.

FIG1-89n/3

FIGURE 1-89 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Fly-Ash Recycle

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG1-89nb/3

FIGURE 1-90: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Clinkers In The Ash Hopper/Pit
(Chain and Traveling Grate Or Vibrating Grate)

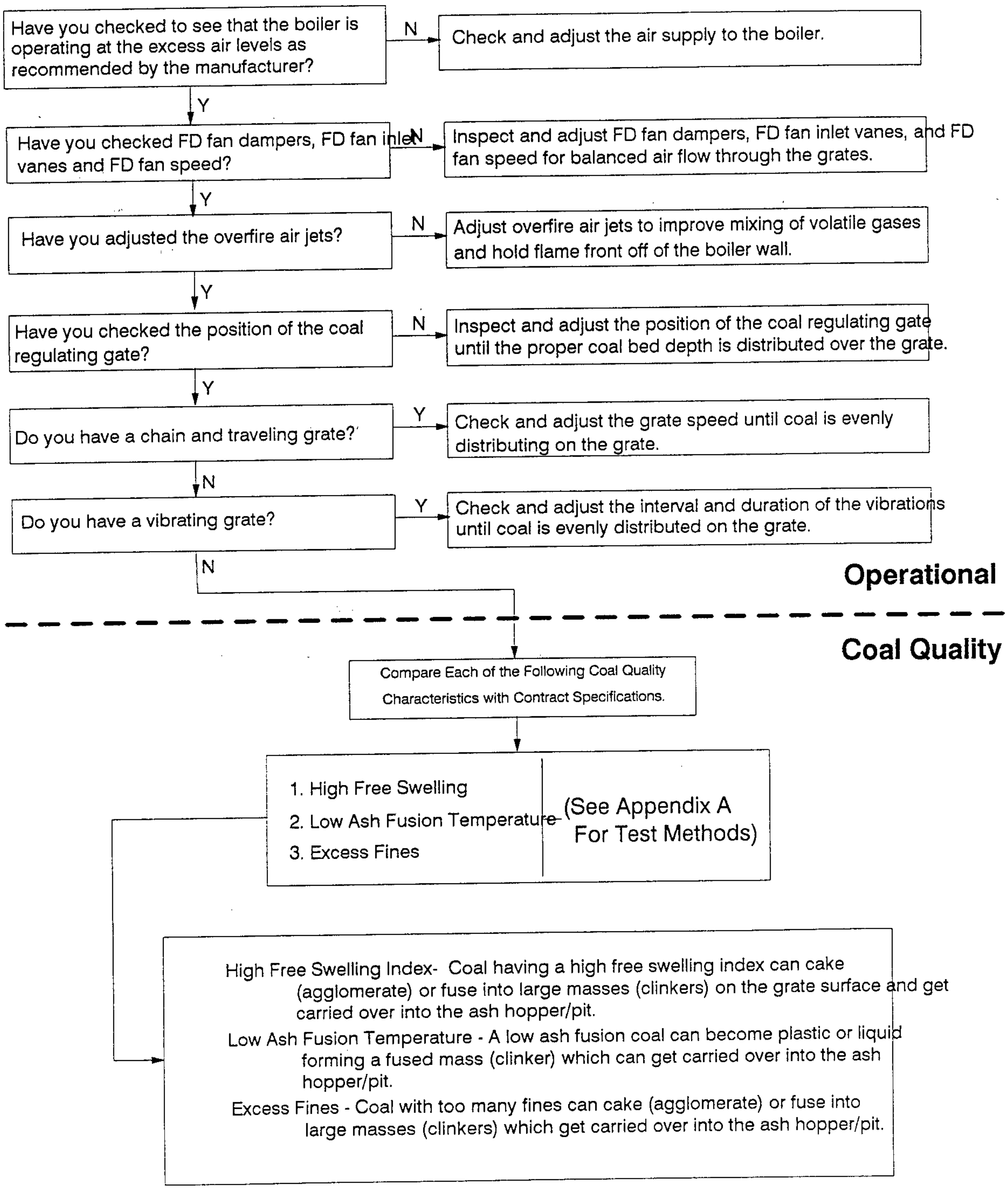


FIG1-90n/3

FIGURE 1-91: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Ash Hopper/Pit

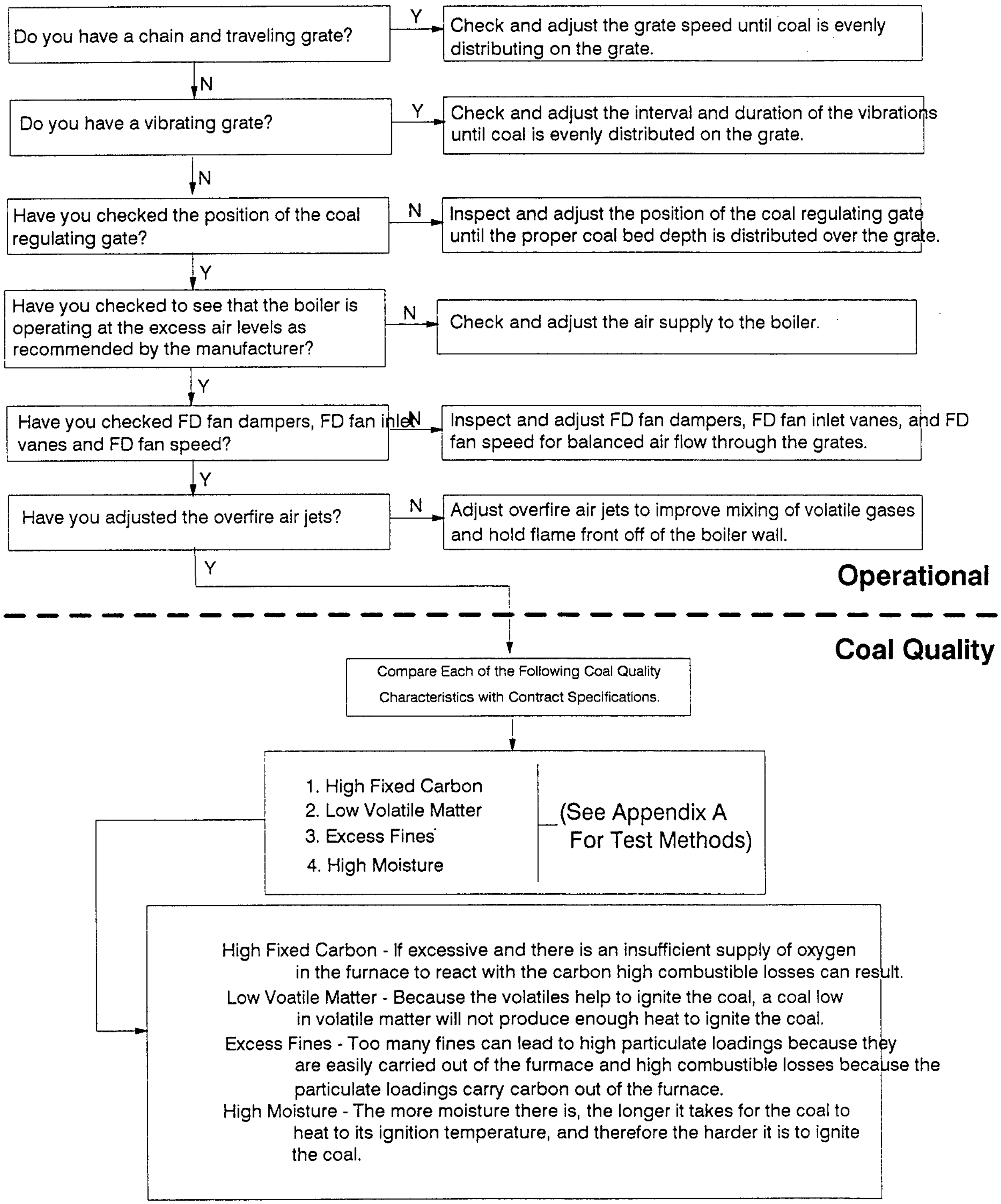


FIG1-91n/3

FIGURE 1-92: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Stack/Chimney

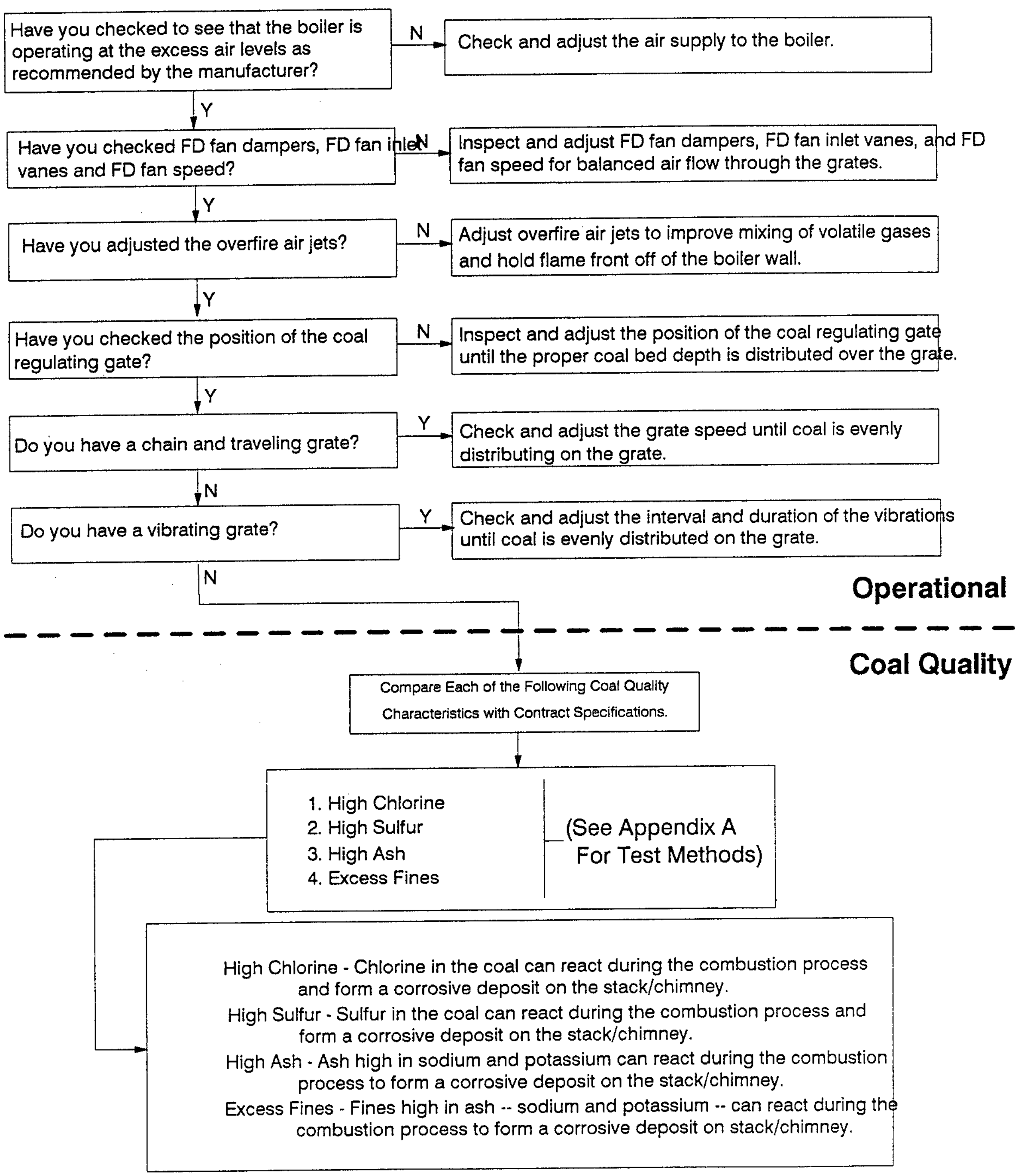
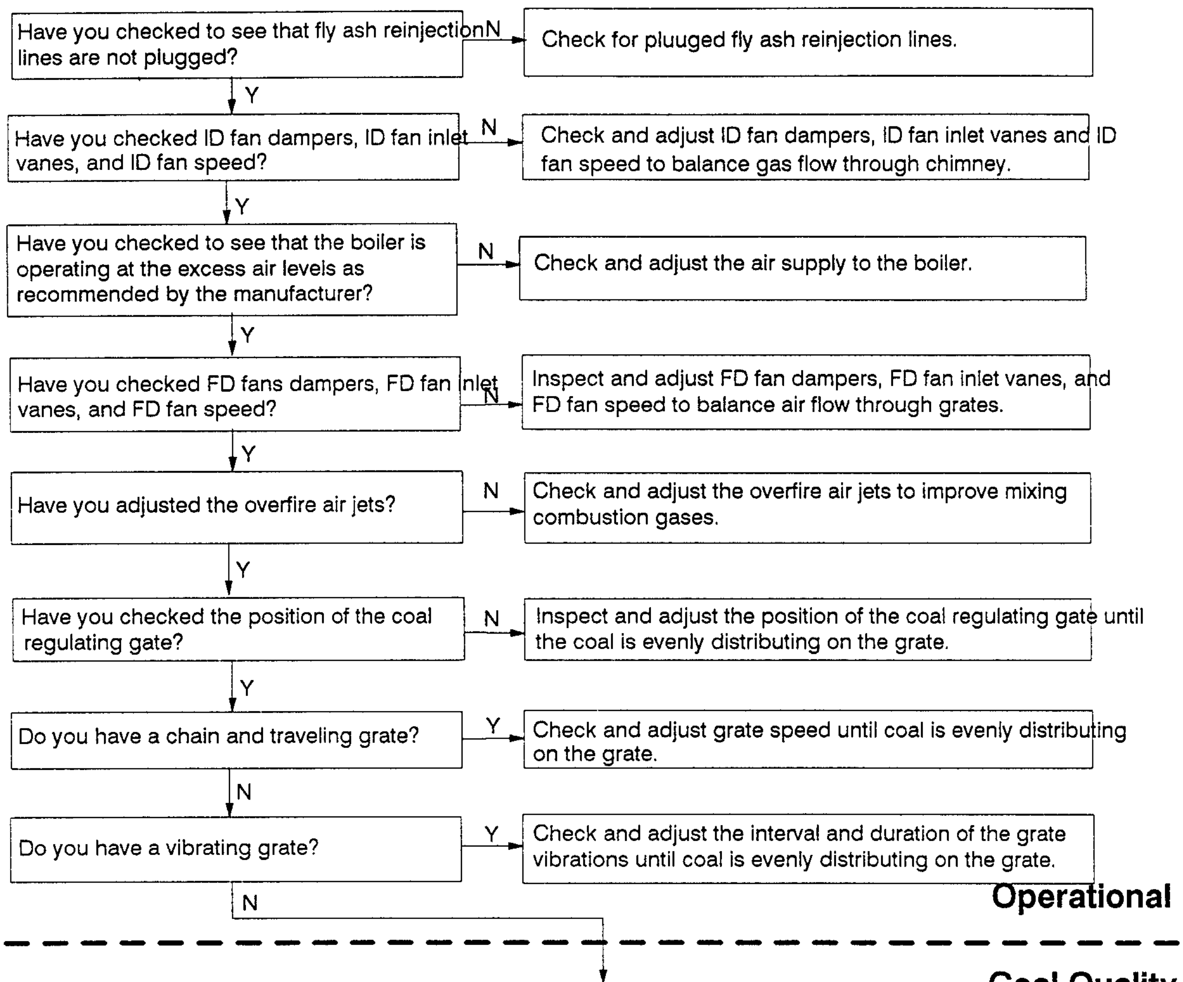


FIG1-92n/3

FIGURE 1-93: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Stack/Chimney



See next page for Coal Quality Section.

FIG1-93n/3

FIGURE 1-93 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

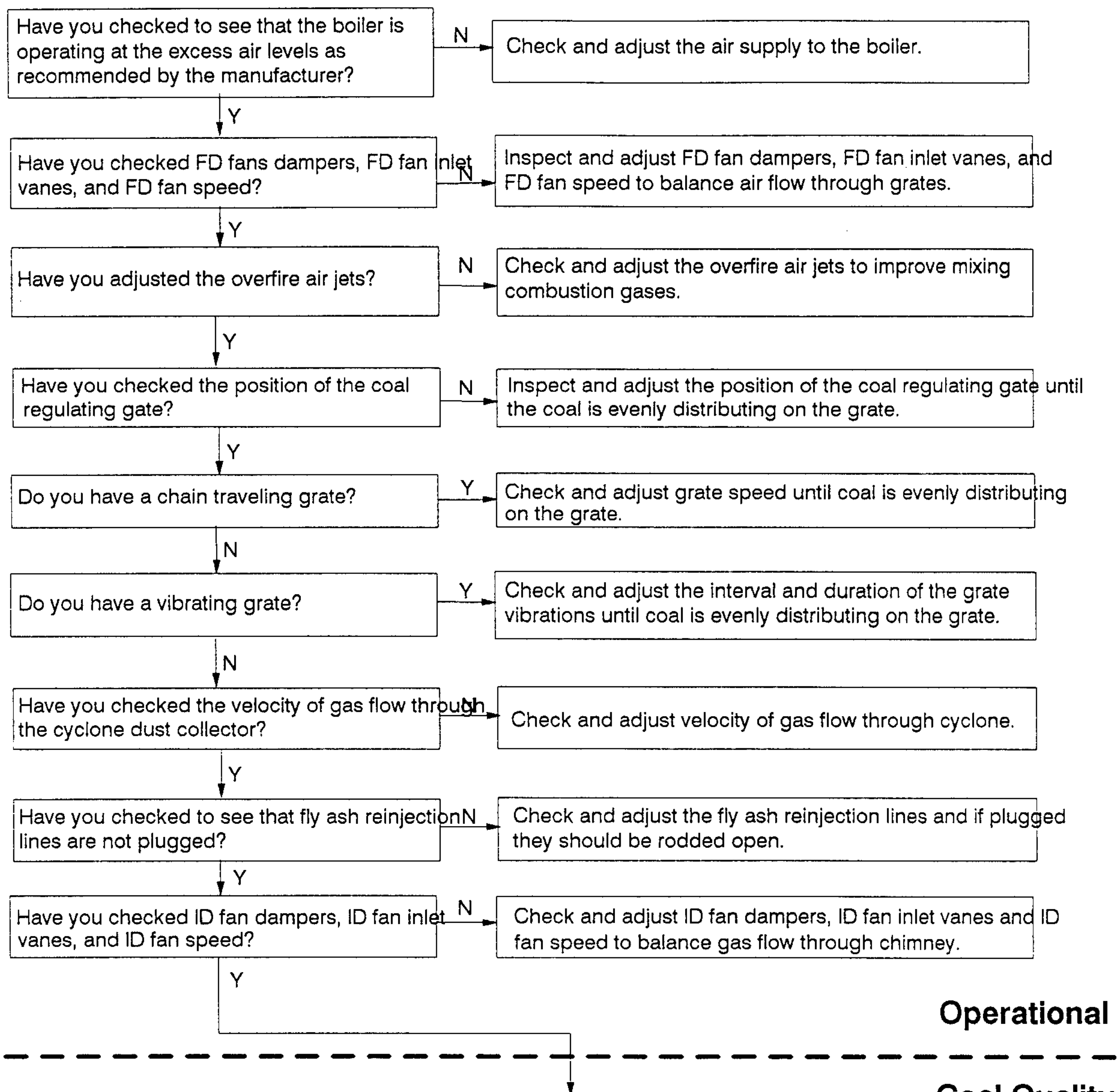
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG1-93nb/3

FIGURE 1-94: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From Stack/Chimney



See next page for Coal Quality Section.

FIG1-94n/3

FIGURE 1-94 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

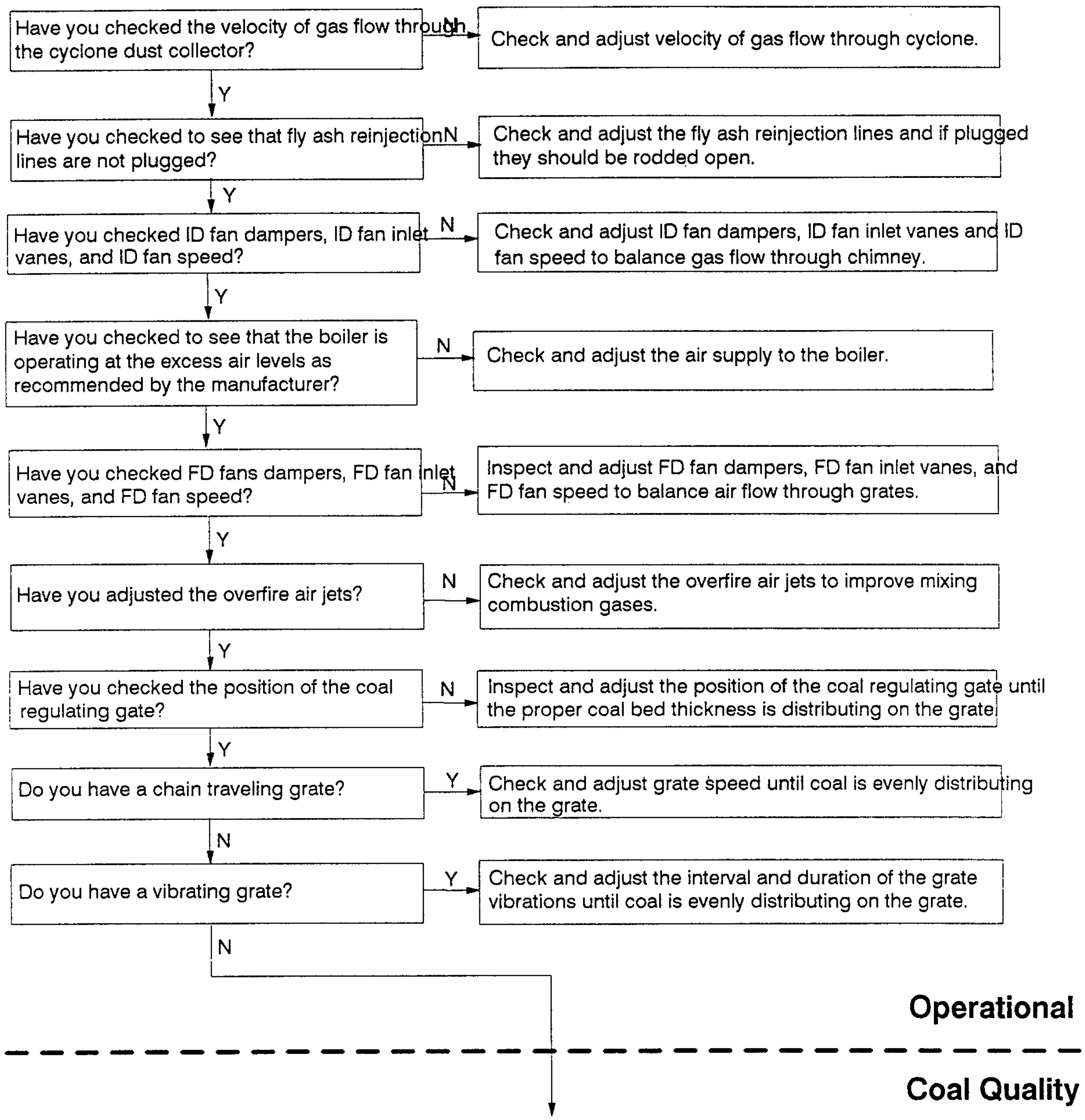
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG1-94nb/3

FIGURE 1-95: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Diagnosing Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIG1-95n/3

FIGURE 1-95 (continued): OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Diagnosing Excess Particulate Emissions From The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG1-95nb/3

FIGURE 1-96: OVERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For SO_2 Emissions From The Stack/Chimney

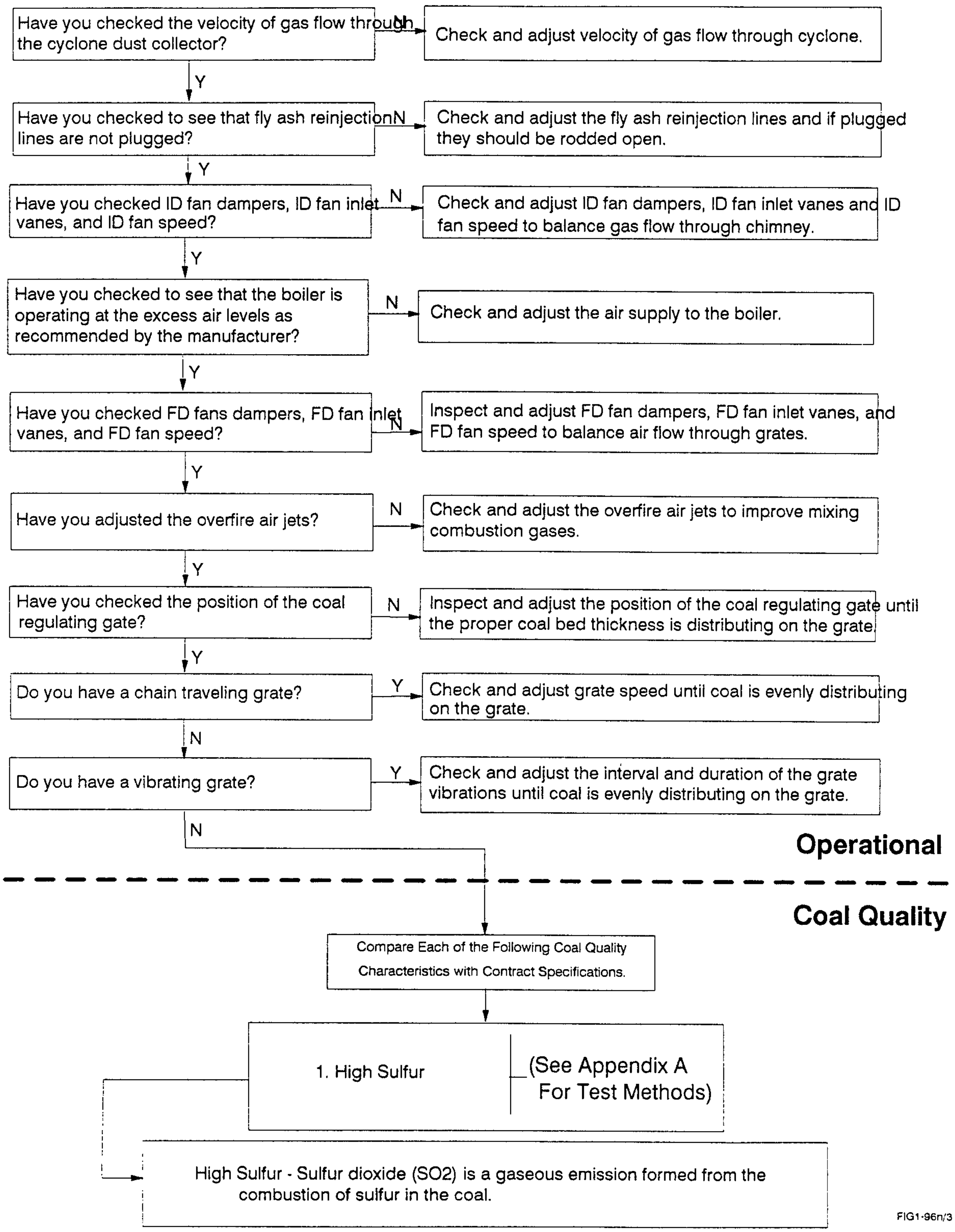


FIG1-96n/3

Appendix B: Spreader Stoker-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality-related problems that can be encountered in spreader stoker-fired boiler systems. A general description of this system is included, but is limited to describing the major components (coal hopper, feeder-distributor mechanism, coal-ash bed grates, damper controls) that make up a complete spreader stoker-fired boiler system. For those interested, more detailed descriptions are provided in references 6, 7, 8.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

B1 System Description

A mechanical stoker is a device equipped with a mechanically operated coal feeding mechanism and a grate. The mechanical stoker is used to feed coal into the boiler, distribute it over a coal ash-bed grate, admit air to the coal bed for combustion and remove or discharge refuse. A specific mechanical stoker type is the spreader stoker.

In a spreader stoker, coal is spread evenly over the entire grate surface by mechanical feeders located at the stoker front above the grate. Because the coal is thrown onto the grate, fine coal particles burn in suspension above the grate. Larger coal particles ignite while in suspension but fall to the grate surface to complete the combustion process.

The spreader-stoker feeder functions to vary the supply of coal to the furnace and to provide even distribution on the grates. In the feeder-and-distributor mechanism (Figure 2-1) there is a reciprocating feed plate that moves coal from the bottom of the hopper over an adjustable spill plate. The length of stroke of this plate determines the rate at which coal is fed into the furnace. The coal leaving the hopper drops from the end of the spilling plate into the path of the rotor blades, which distribute the coal on the grates. The in-and-out adjustment of the spilling plate changes the point at which coal comes in contact with the rotor blades. Moving the spilling plate back from the furnace allows the coal to fall on the rotor blades sooner. The blades impact more energy to the coal, and it is thrown farther into the furnace. Increasing the rotor speed impacts more force to the coal, throwing it farther into the furnace.

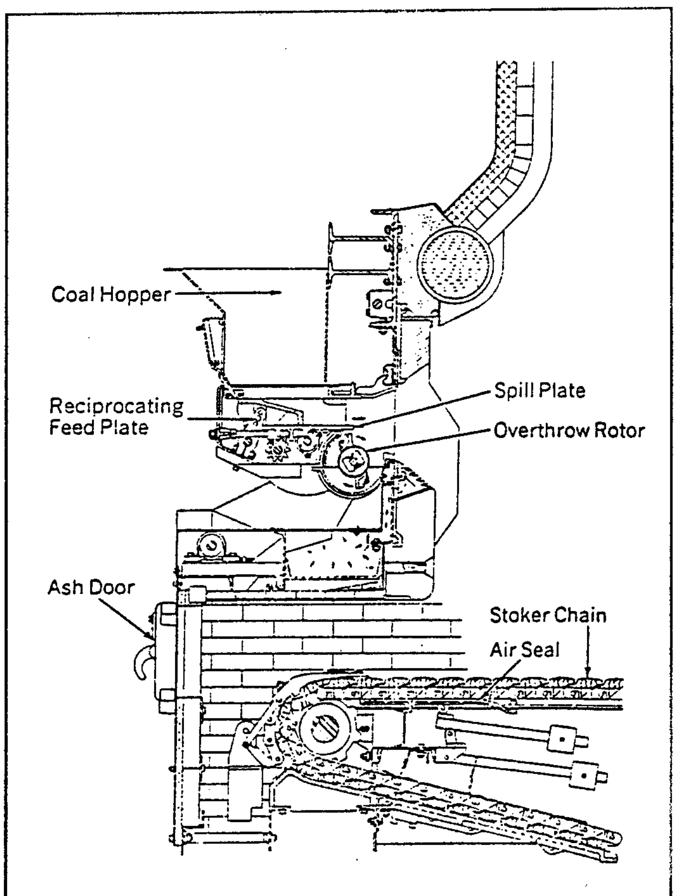


Figure 2-1. Overthrow spreader stoker with feeder and distributor mechanism.

Air for combustion is supplied to spreader stokers by forced-draft fans. Air is forced through the fuel bed from underneath the grates (Figure 2-2). Suspension burning

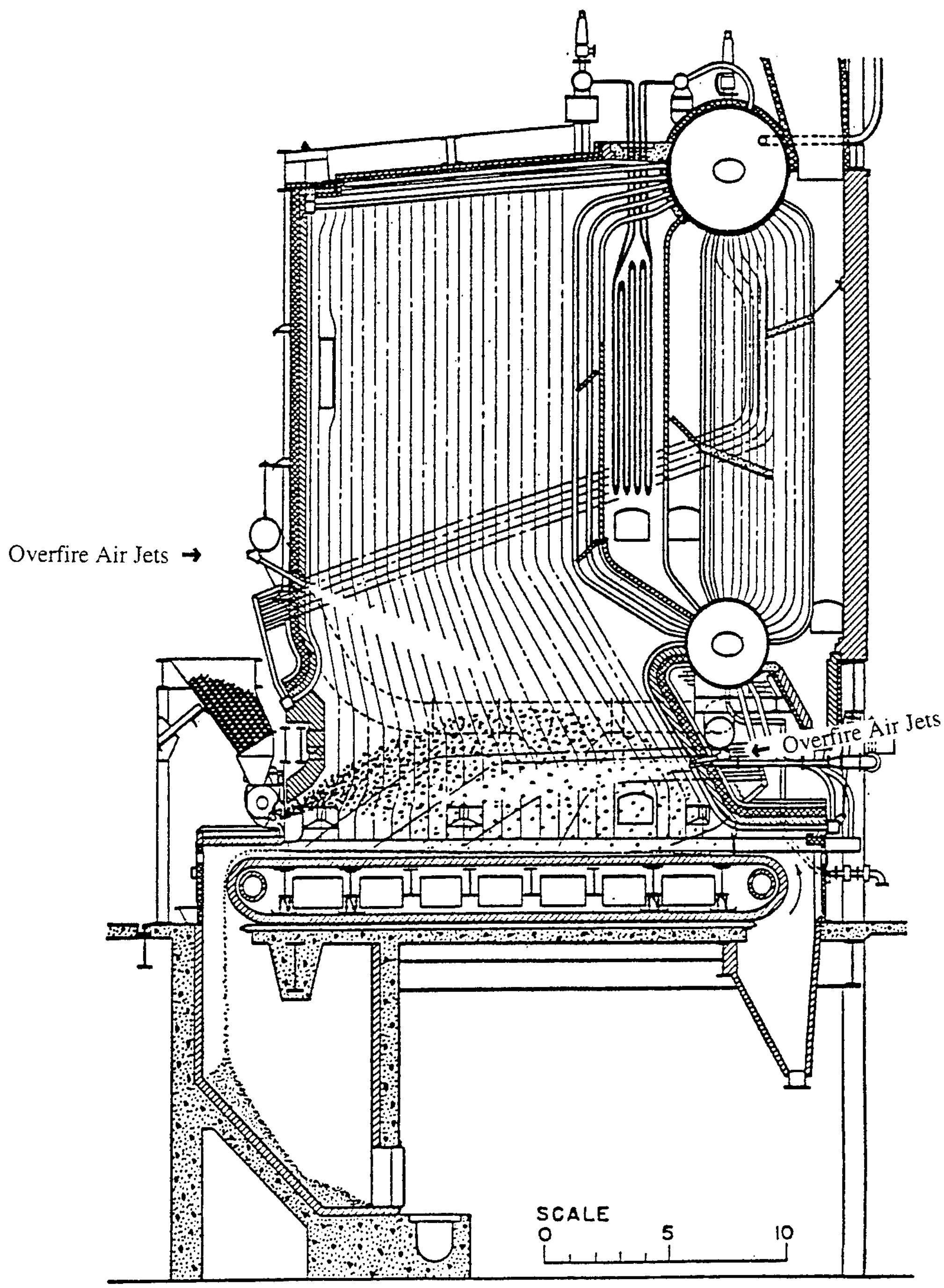


Figure 2-2. Ovverfire air jets.

also requires a supply of air directly to the furnace. This air is supplied by a high pressure blower and enters the furnace through ports in the walls. Such over-fire air jets provide not only combustion air but create turbulence in the furnace to mix combustible gases and provide air needed to reinject cinders from collecting hoppers.

Spreader stokers may have one of several grate types:

- *Stationary Grates.* The feeder automatically deposits coal on the grates, and air for combustion enters the furnace through holes in the grate. At least two feeders are used, and before the ash deposits become deep enough to restrict airflow, one of the feeders is taken out of service. The fuel on the grate is allowed to burn to completion and the ash is raked through the furnace door. The feeder is then started, and after combustion has been reestablished, the remaining grate sections are cleaned in like manner.

- *Dumping Grates.* (Figure 2-3) Each grate bar is tipped or opened like a venetian blind so that ash will fall into an ash pit. The tipping of grate bars can be accomplished by hand operation or automatically. The procedure of taking one feeder section out of service long enough to remove ash is the same as when stationary grates are used.

- *Traveling Grates.* (Figure 2-4) The coal falls on the grate, and combustion is completed as it moves slowly through the furnace. The ash remains and falls into the pit when the grates pass over the sprocket. Ash discharge is at the rear of the furnace.

- *Vibrating Grates.* The grates are mounted on a pivoted framework, a motor vibrates the assembly, and the ash moves along the grates toward the ash pit. The motor that produces the vibration is run at intervals by a timer. The off-on-off cycles are varied to obtain the desired depth of ash at the discharge end of the grate.

- *Overlapping (Reciprocating) Grates.* Overlapping grates are similar to shingles on the roof of a house. The grate bars are mechanically driven and move back and forth, alternately increasing and decreasing in the amount of overlap. This motion causes the ash to shift from one grate to the other and slowly move toward the ash pit. The rate of ash discharge is varied by changing the amount of travel of the grate bars.

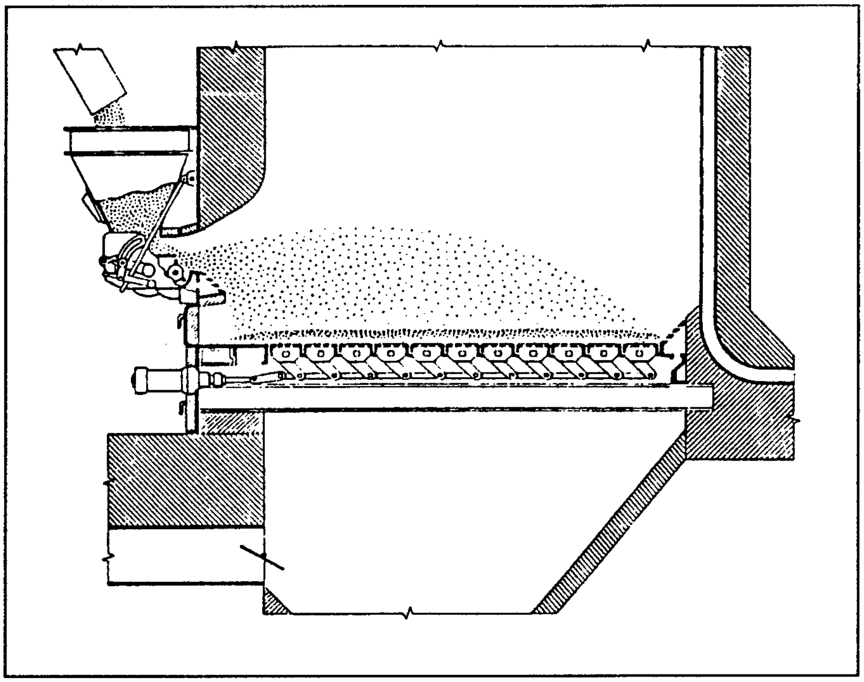


Figure 2-3. Dumping grate.

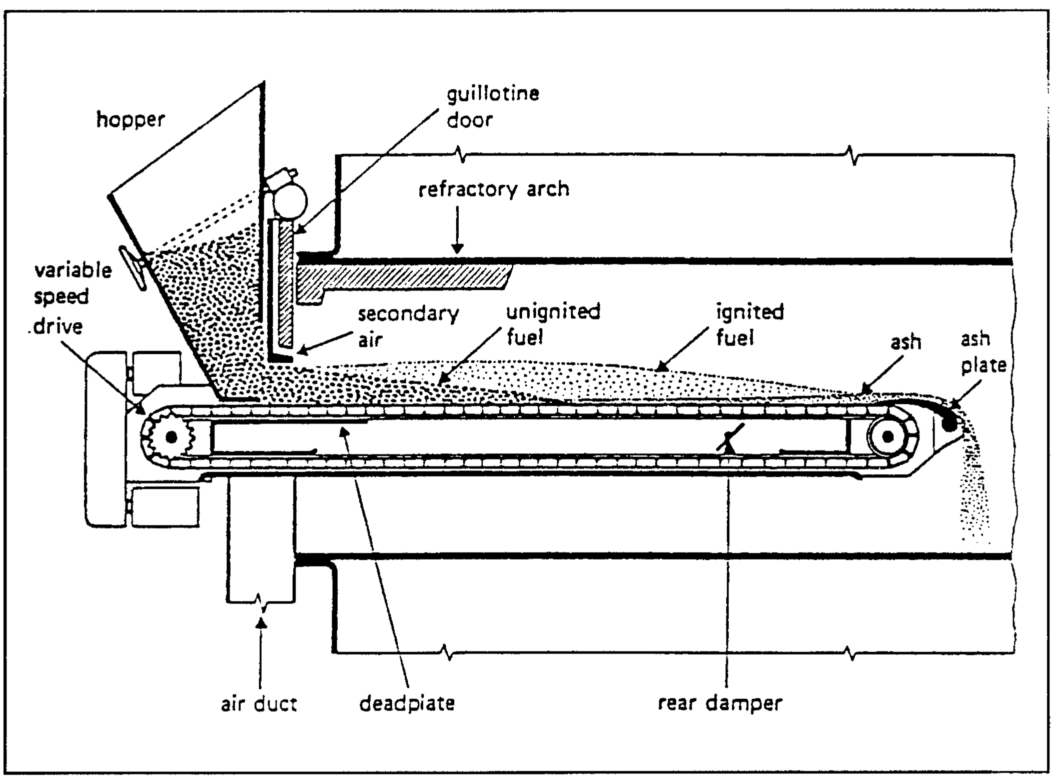


Figure 2-4. Traveling grate.

The spreader stoker is characterized by a thin bed and partial suspension, high availability, and high operating efficiency. Despite being able to fire coals of differing quality and respond to rapid load changes, it has high flyash carryover and high flyash combustible heat loss. Flyash (cinder) reinjection is used to recover some carbon in the collected flyash.

B2 Block Flow Diagram

The spreader stoker-fired boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality), sequentially arranged to show:

- coal flow through the coal handling equipment
- flue gas flow through the boiler/components, ash recycle and flue gas cleanup (FGC) subsystem, the induced draft fan and chimney/stack
- ash discharge to the ash hopper/pit.

These specific components are identified in Figure 2-5. The first six components have been grouped collectively under a category entitled coal handling equipment. The coal handling equipment includes all components that process the coal from its delivery on site to the coal feeder mechanism. It includes equipment that, depending on plant design, may include:

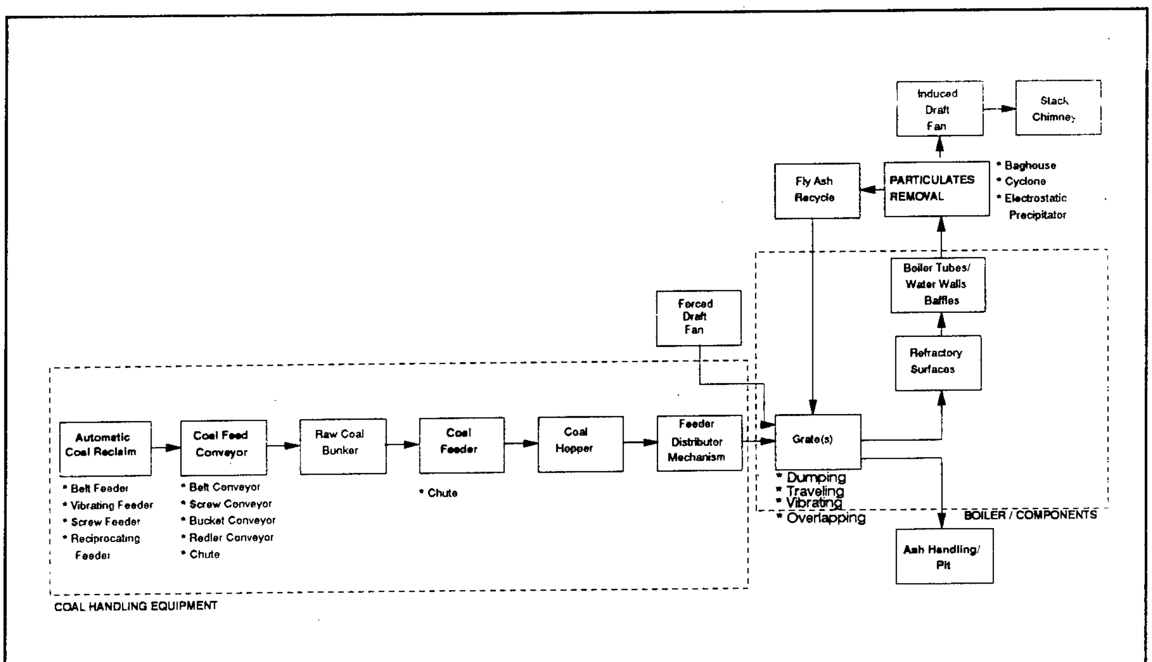


Figure 2-5. Spreader stoker-fired boiler system components block flow diagram.

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders, and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- coal feeders that transport coal to the stoker coal hopper
- coal feeder mechanism that serves to control coal flow rate into the boiler.

The next five components have been loosely grouped under the category entitled Boiler/Components, which includes equipment that, depending on plant design, may include:

- forced draft fan
- grates—specifically dumping grates, traveling grates, vibrating grates, and overlapping reciprocating grates
- refractory surfaces
- boiler tubes, water walls and baffle.

The next two blocks represent the flyash recycle and particulate removal subsystems. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. Spreader stoker-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the guide include:

- forced draft (FD) Fans, which supply undergrate air
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the Guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/pit.

B3 Troubleshooting Logic

The component/symptom table (Figure 2-6) serves to identify:

- Typical symptoms (problems) that may be encountered in a spreader stoker-fired boiler systems. These symptoms are arranged horizontally along the top of the table.
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram.
- The logic diagrams.

The remainder of this Appendix consists of 92 logic diagrams, arranged by component and all the symptoms that can affect that component.

FIGURE 2-6 (Part 1): SPREADER STOKER - COMPONENT/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																				
Automatic Coal Reclaim																				
1) Belt Feeder	● 2-7	● 2-8	● 2-9	● 2-10																
2) Vibrating Feeder	● 2-11	● 2-12	● 2-13	● 2-14																
3) Screw Feeder	● 2-15	● 2-16	● 2-17	● 2-18																
4) Reciprocating Feeder	● 2-19	● 2-20	● 2-21	● 2-22																
Coal Feed Conveyor																				
1) Belt Conveyor	● 2-23	● 2-24	● 2-25	● 2-26																
2) Screw Conveyor	● 2-27	● 2-28	● 2-29	● 2-30																
3) Bucket Conveyor	● 2-31	● 2-32	● 2-33	● 2-34																
4) Redler Conveyor	● 2-35	● 2-36	● 2-37	● 2-38																
5) Chute		● 2-39	● 2-40	● 2-41																

Figure 2-6. Spreader stoker—component symptom guide (part 1).

FIGURE 2-6 (Part 2): SPREADER STOKER - COMPONENT/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIP.(CONT																				
Coal Feeders																				
Chute		• 2-42	• 2-43	• 2-44																
Coal Bunker		• 2-45	• 2-46	• 2-47																
Coal Hopper		• 2-48	• 2-49	• 2-50																
Feeder Distributor Mechanism	• 2-51	• 2-52	• 2-53	• 2-54																
BOILER / COMPONENTS																				
Boiler			• 2-55											• 2-56						
1) Grates					• 2-57	• 2-58	• 2-59	• 2-60	• 2-61	• 2-62	• 2-63	• 2-64	• 2-65							
2) Refractory Surfaces					• 2-66											• 2-67	• 2-68			
3) Boiler Tubes/Water Walls					• 2-69											• 2-70	• 2-71	• 2-72		
4) Baffles					• 2-73											• 2-74	• 2-75	• 2-76		

Figure 2-6. Spreader stoker—component symptom guide (part 2).

FIGURE 2-6 (Part 3): SPREADER STOKER - COMPONENTS/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
FANS																				
1) Forced Draft			• 2-77												• 2-78					
2) Induced Draft			• 2-79		• 2-80										• 2-81	• 2-82				
PARTICULATE REMOVAL																				
1) Baghouse													• 2-83						• 2-84	
2) Cyclone													• 2-85			• 2-86			• 2-87	
3) Electrostatic Precipitator													• 2-88			• 2-89			• 2-90	
ASH HANDLING																				
1) Fly Ash Recycle													• 2-91							
2) Ash Hopper/Pit												• 2-92	• 2-93							
Stack/Chimney					• 2-94								• 2-95		• 2-96				• 2-97	• 2-98

Figure 2-6. Spreader stoker—component symptom guide (part 3).

FIGURE 2-7: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim

(Belt Feeder)

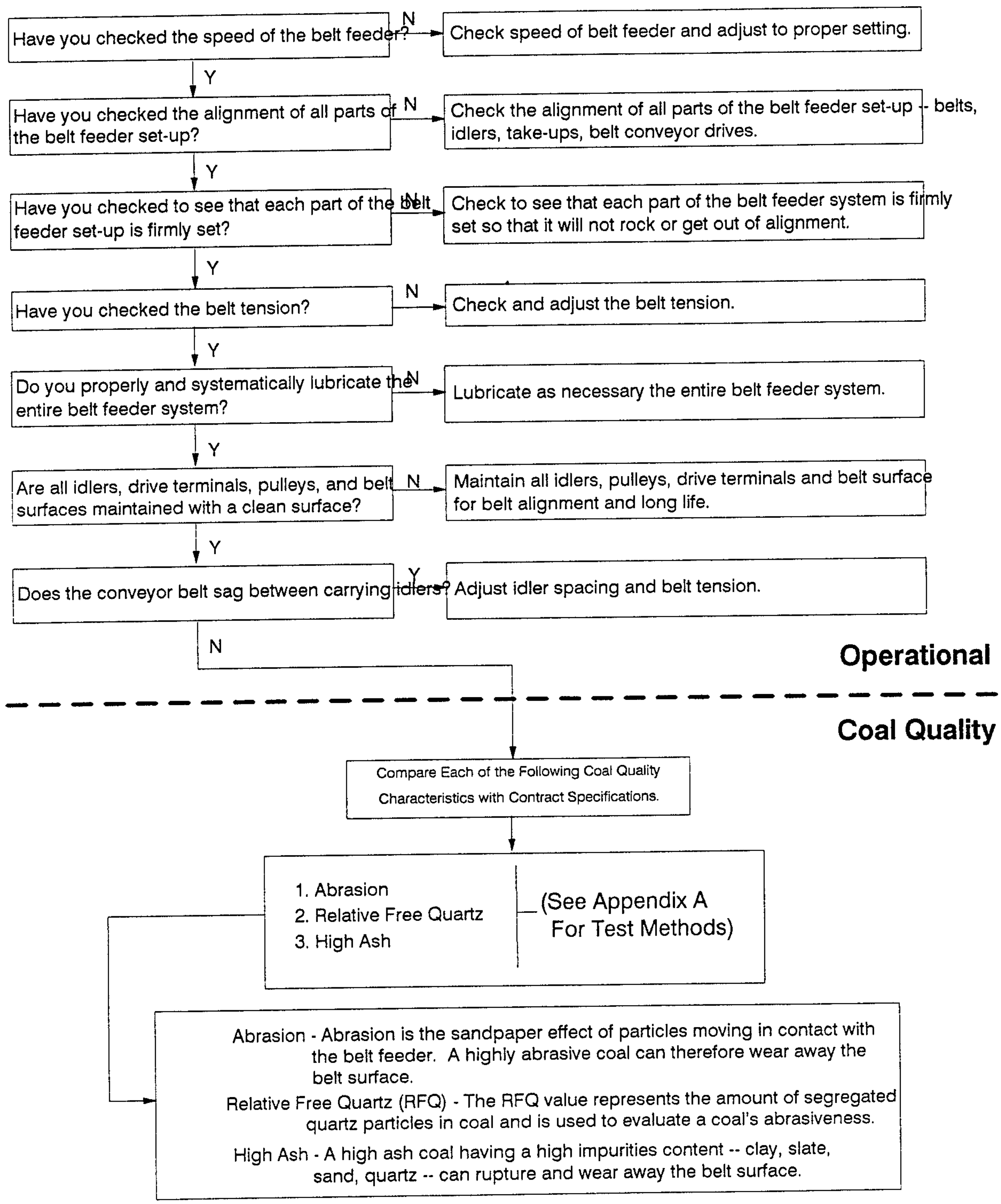


FIG2-7n/1

FIGURE 2-8: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Belt Feeder)

* Have you checked to see that large peices of coal, wood, or other foreign objects have not become lodged between the belt and the discharge opening onto the belt?
- N → Check for and remove any large pieces of coal, wood or other foreign objects that may have become lodged between the belt and discharge opening onto the belt.
- Y ↓

* Have you checked for fine damp coal that may have become packed between the belt and the discharge opening onto the belt?
- N → Check for fine damp coal that may have become packed between the belt and the discharge opening onto the belt.
- Y ↓

Have you checked the speed of the belt?
- N → Check and adjust the speed of the belt.
- Y ↓

Have you checked to see that the belt is in proper working condition?
- N → Check to see that the belt is in proper working condition. NOTE: See Operational Section of Figure 4-7.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high ash and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG2-8n/1

FIGURE 2-9: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Belt Feeder)

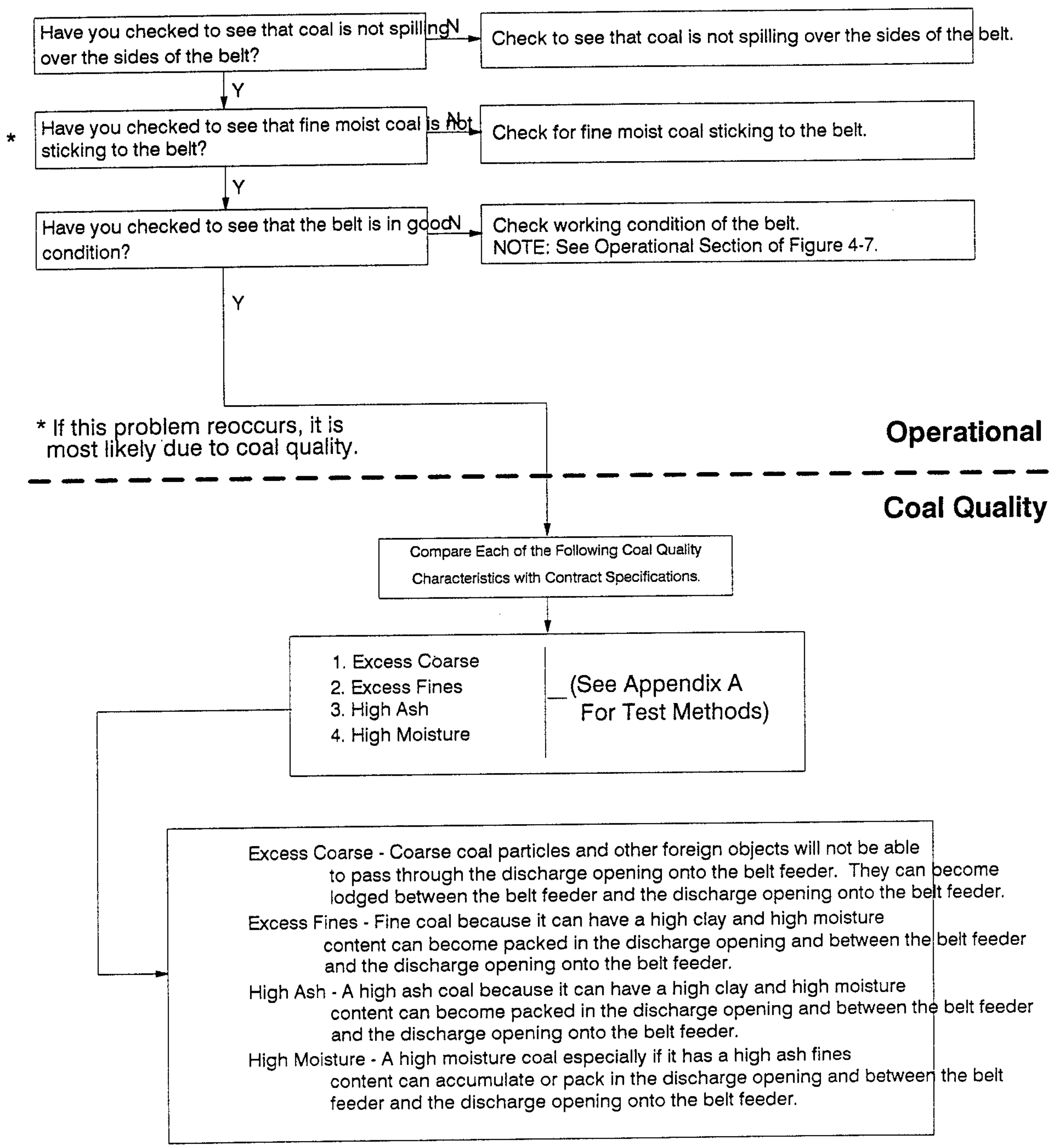


FIG2-9n/1

FIGURE 2-10: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Belt Feeder)

- * Have you checked to see that fine damp coal is not sticking to the belt?
  - N → Check to see that fine damp coal is not sticking to the belt.
  - Y ↓
- Have you checked to see that coal is not spilling over the sides of the belt?
  - N → Check to see that coal is not spilling over the sides of the belt.
  - Y ↓
- Have you checked the condition of the belt and the conveyor belt system?
  - N → Check the working condition of the belt. NOTE: See Operational Section of Figure 4-7.
  - Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG2-10n/1

FIGURE 2-11: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim (Vibrating Feeder)

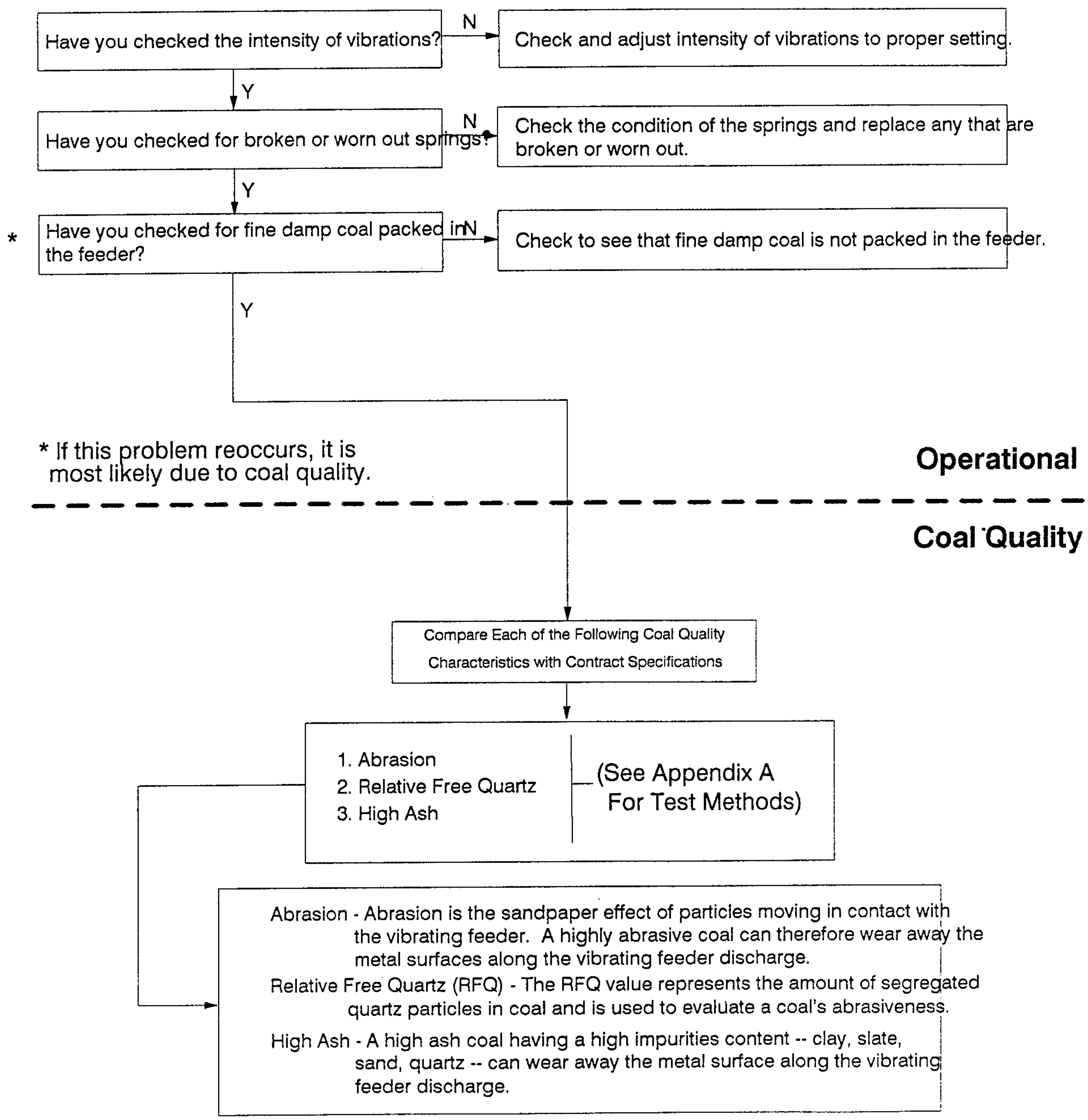


FIG2-11n/1

FIGURE 2-12: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Vibrating Feeder)

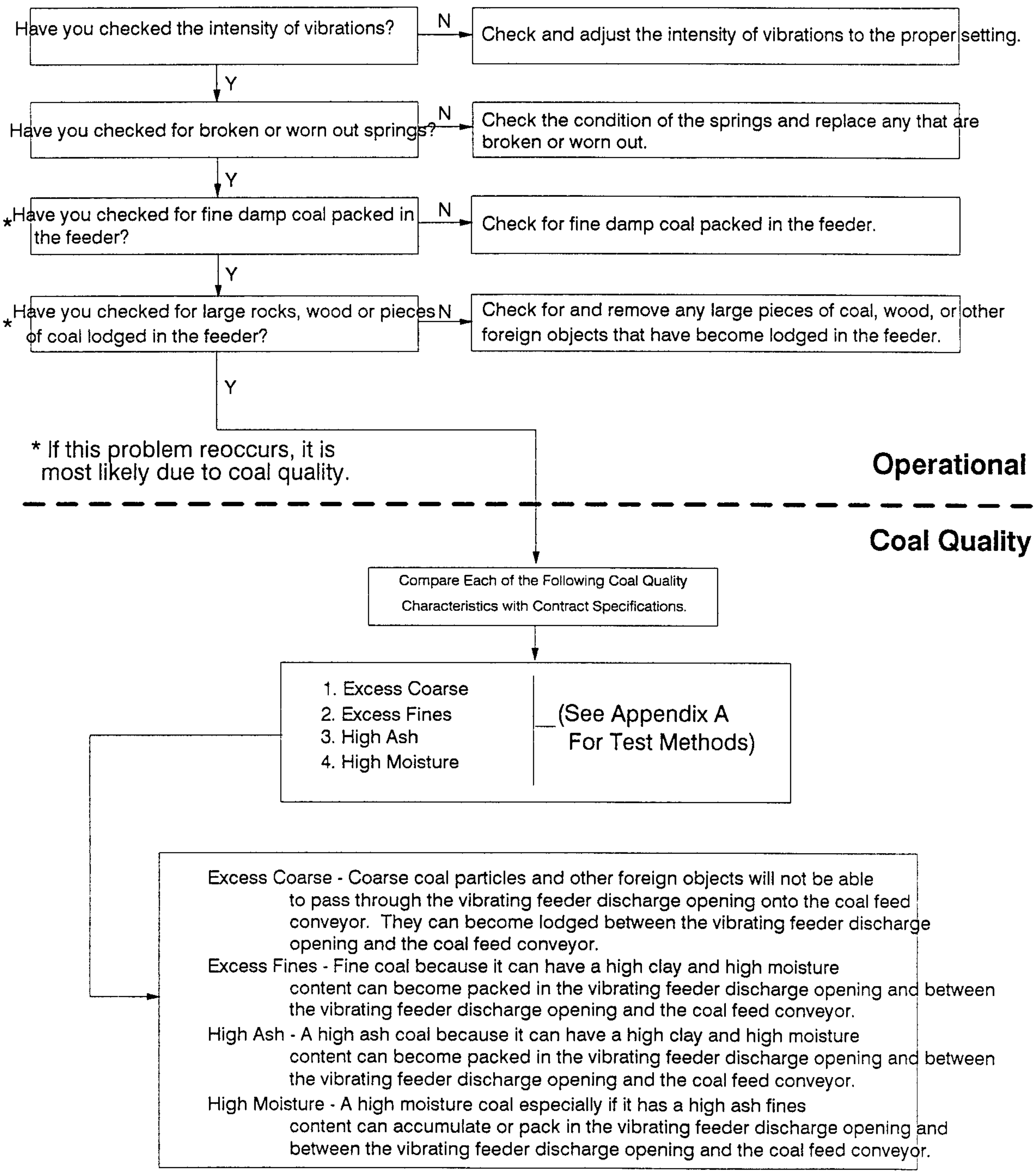


FIG2-12n/1

FIGURE 2-13: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Vibrating Feeder)

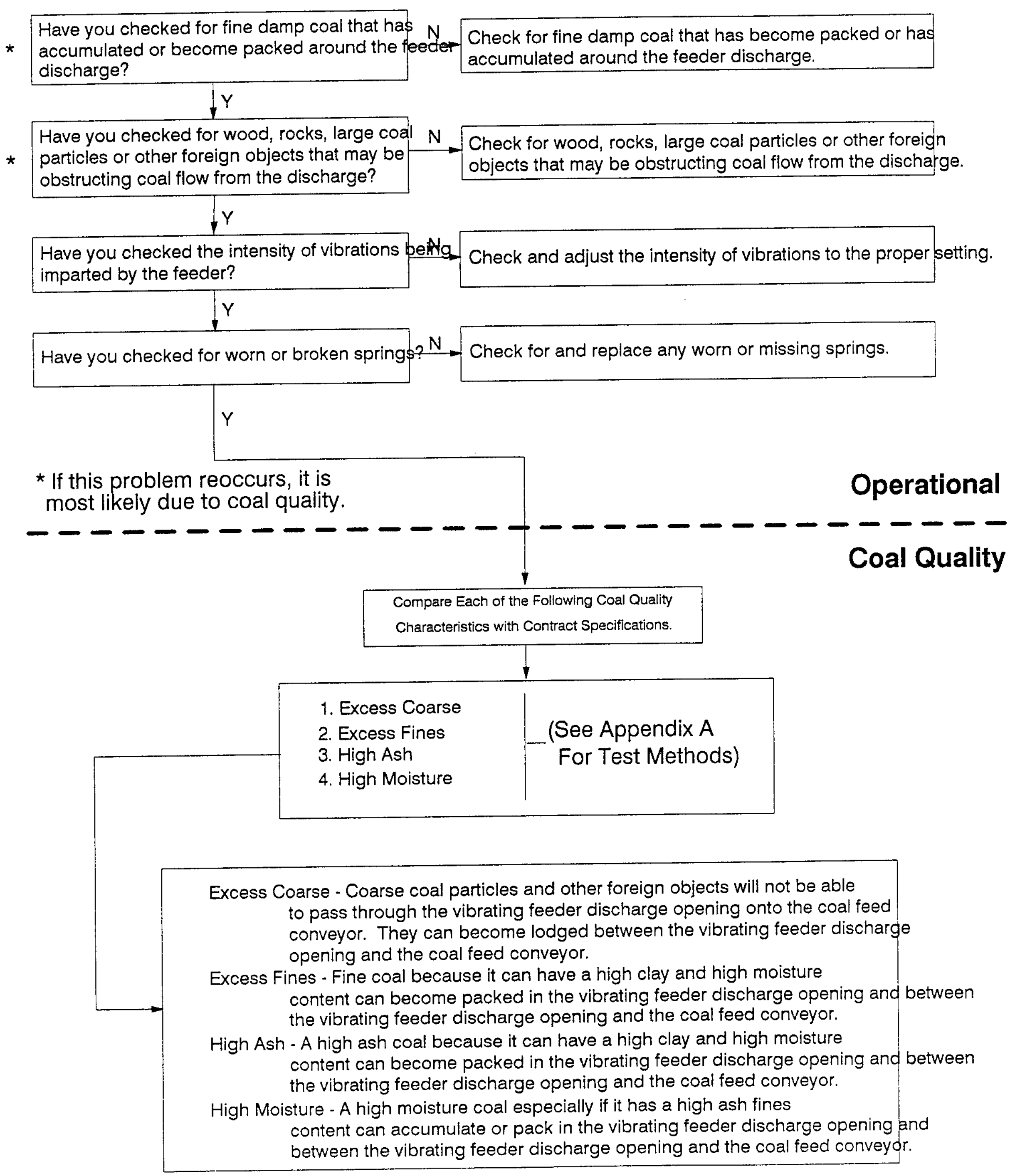


FIG2-13n/1

FIGURE 2-14: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Vibrating Feeder)

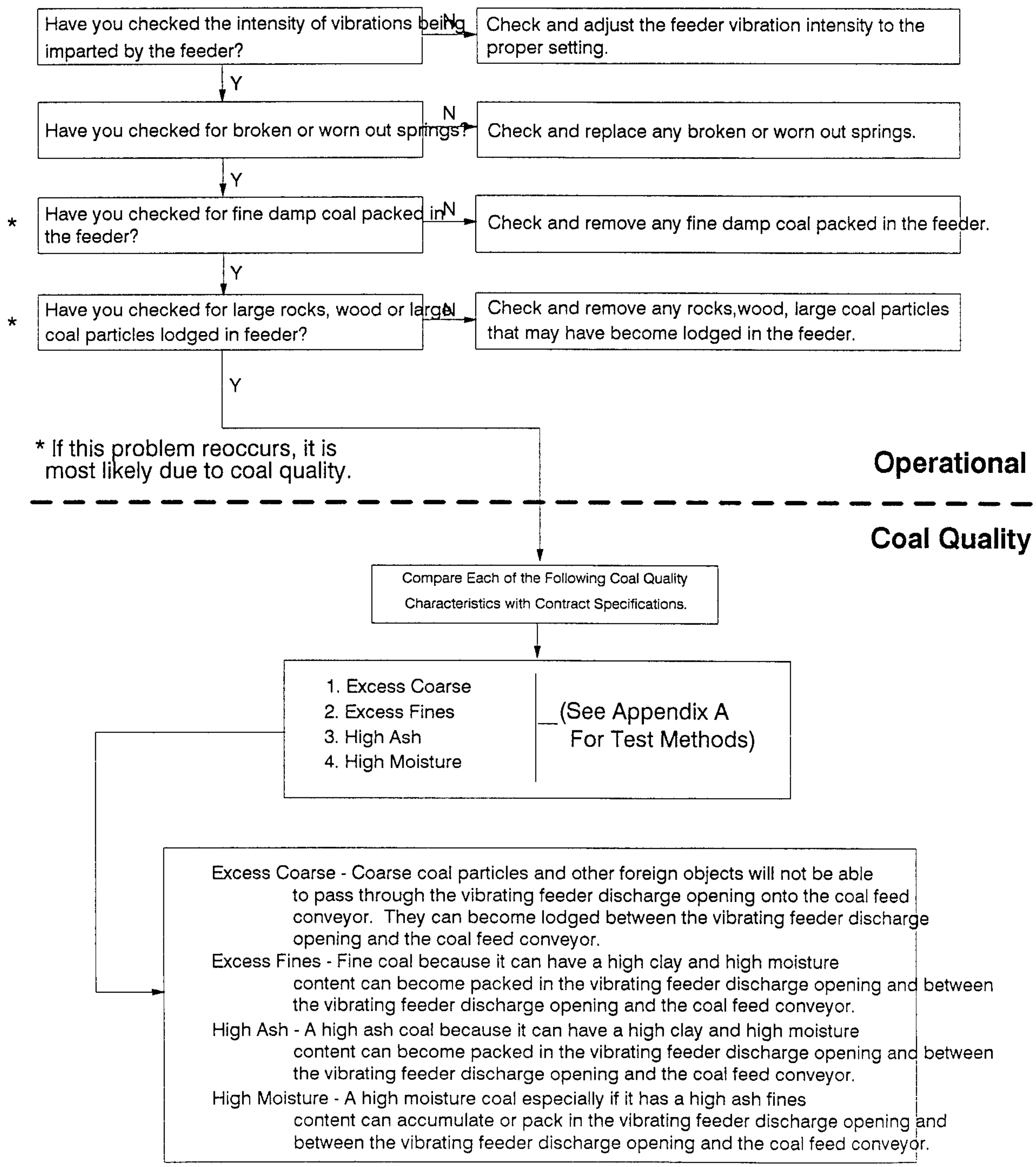


FIG2-14n/1

FIGURE 2-15: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim (Screw Feeder)

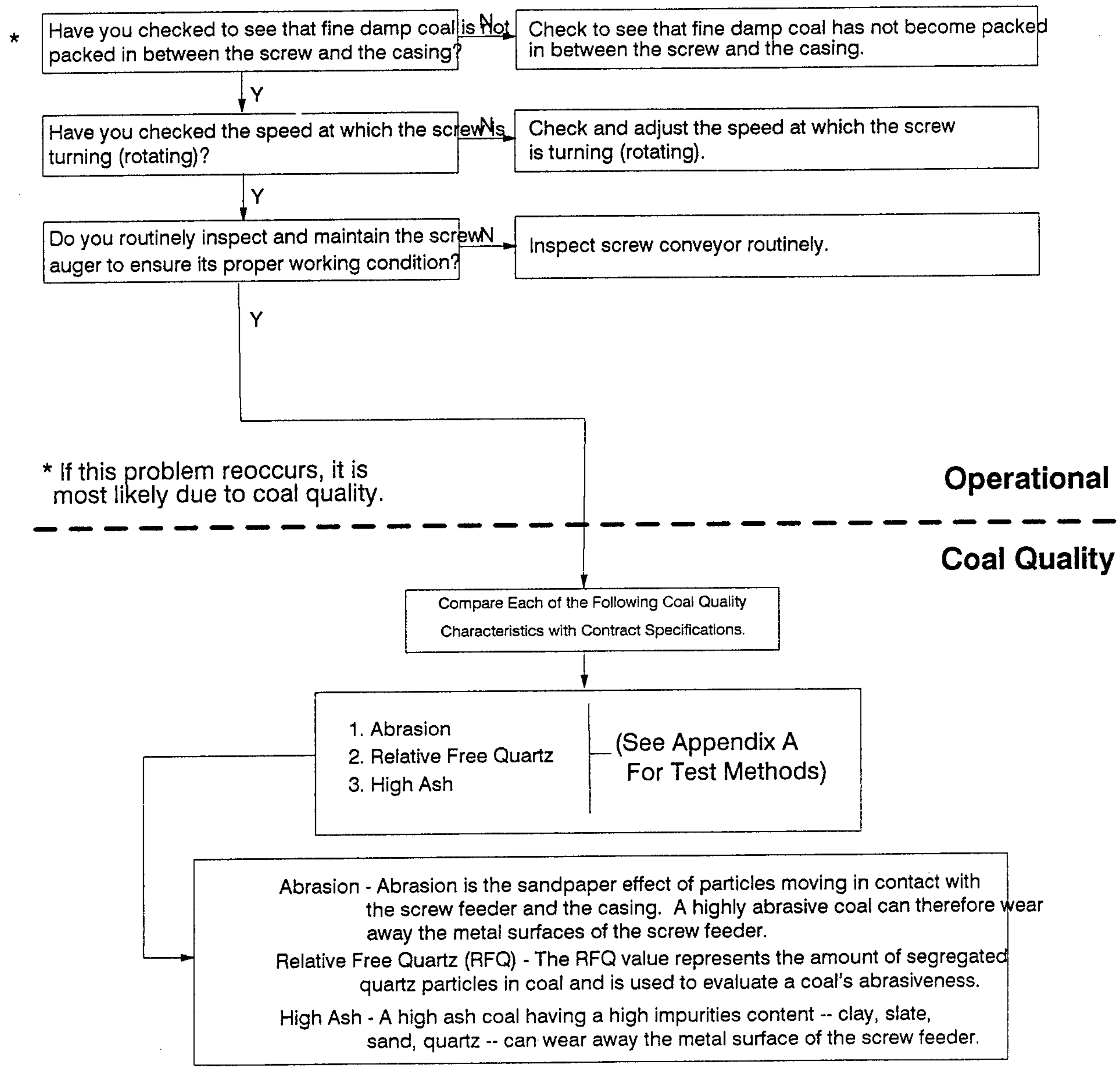


FIG2-15n/1

FIGURE 2-16: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Screw Feeder)

Is the auger turned on?	N →	Turn on the auger.
Y ↓		
Have you checked the speed of the screw?	N →	Check and adjust the speed of the screw.
Y ↓		
* Have you checked for large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor?	N →	Check for and remove any large rocks, wood, pieces of coal or or other foreign objects preventing coal flow onto the coal feed conveyor.
Y ↓		
* Have you checked for frozen coal?	N →	Check for and dislodge any frozen coal.
Y ↓		
* Have you checked for fine damp coal packed between the screw and the casing?	N →	Check for fine damp coal that may be packed between the screw and the casing.
Y ↓		

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw feeder and the casing surrounding the screw feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw feeder and the casing surrounding the screw feeder.

FIG2-16n/1

FIGURE 2-17: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Screw Feeder)

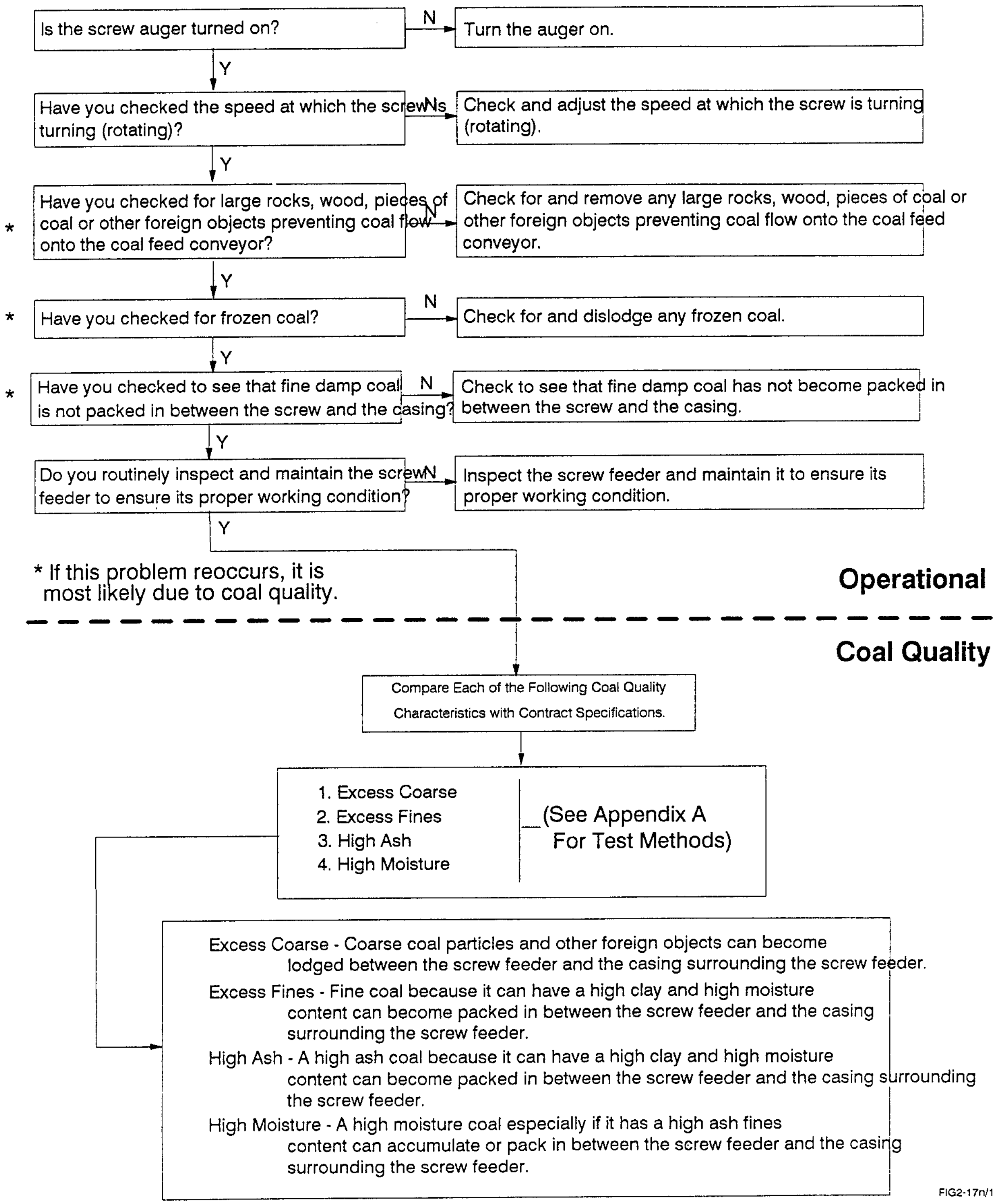


FIG2-17n/1

FIGURE 2-18: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feed From The Automatic Coal Reclaim (Screw Feeder)

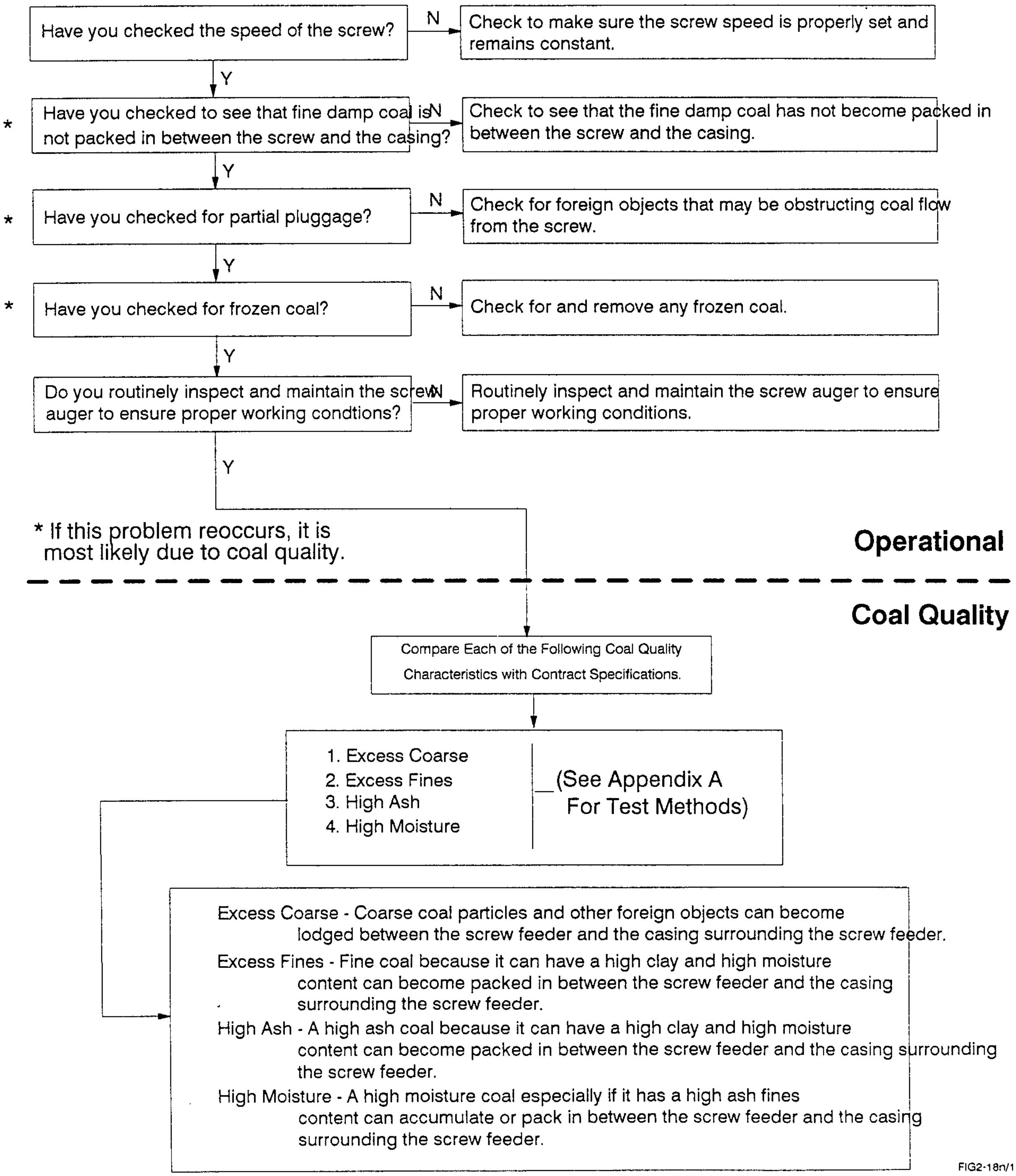


FIG2-18n/1

FIGURE 2-19: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Reciprocating Feeder)

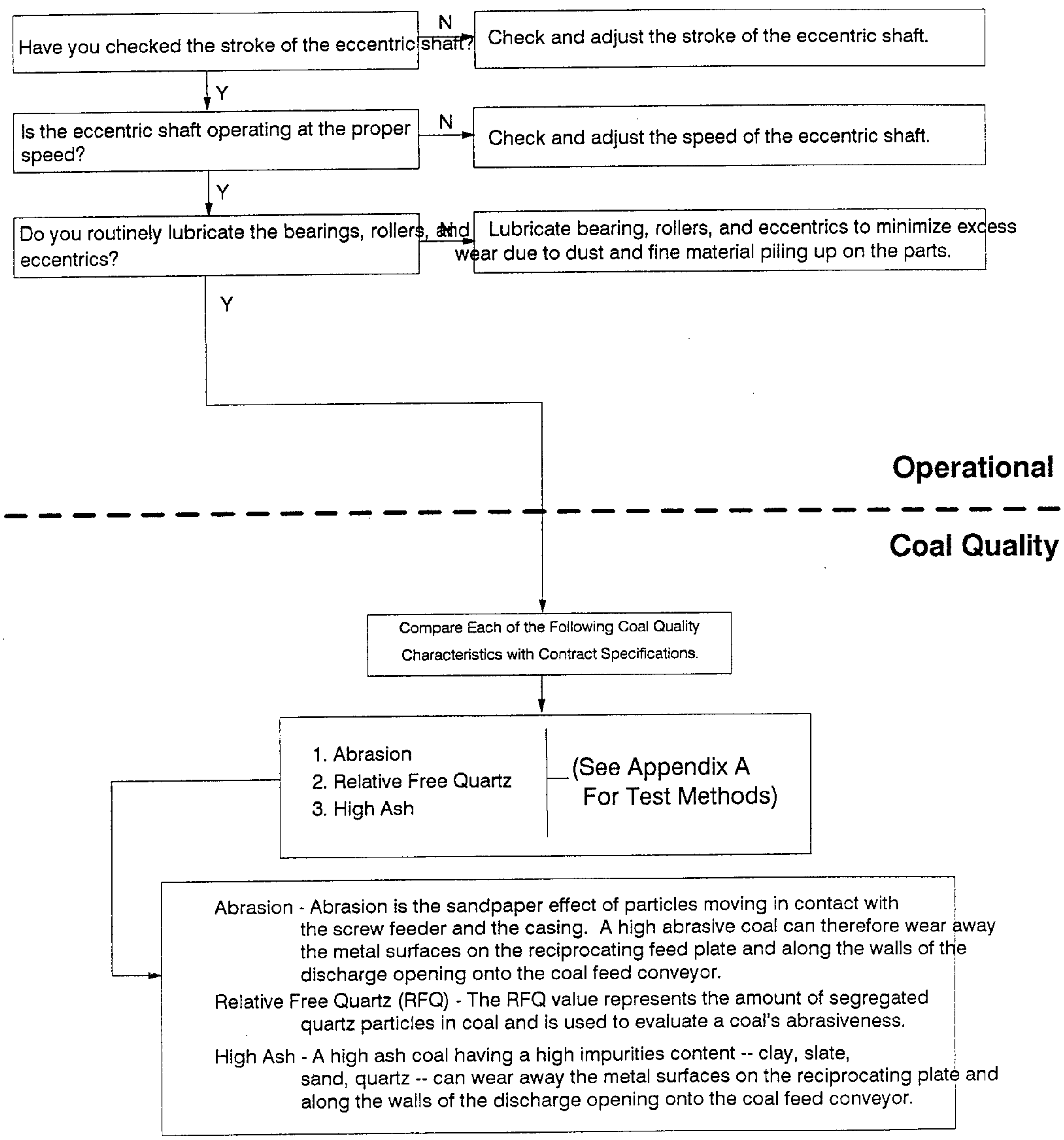


FIG2-19n/1

FIGURE 2-20: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Reciprocating Feeder)

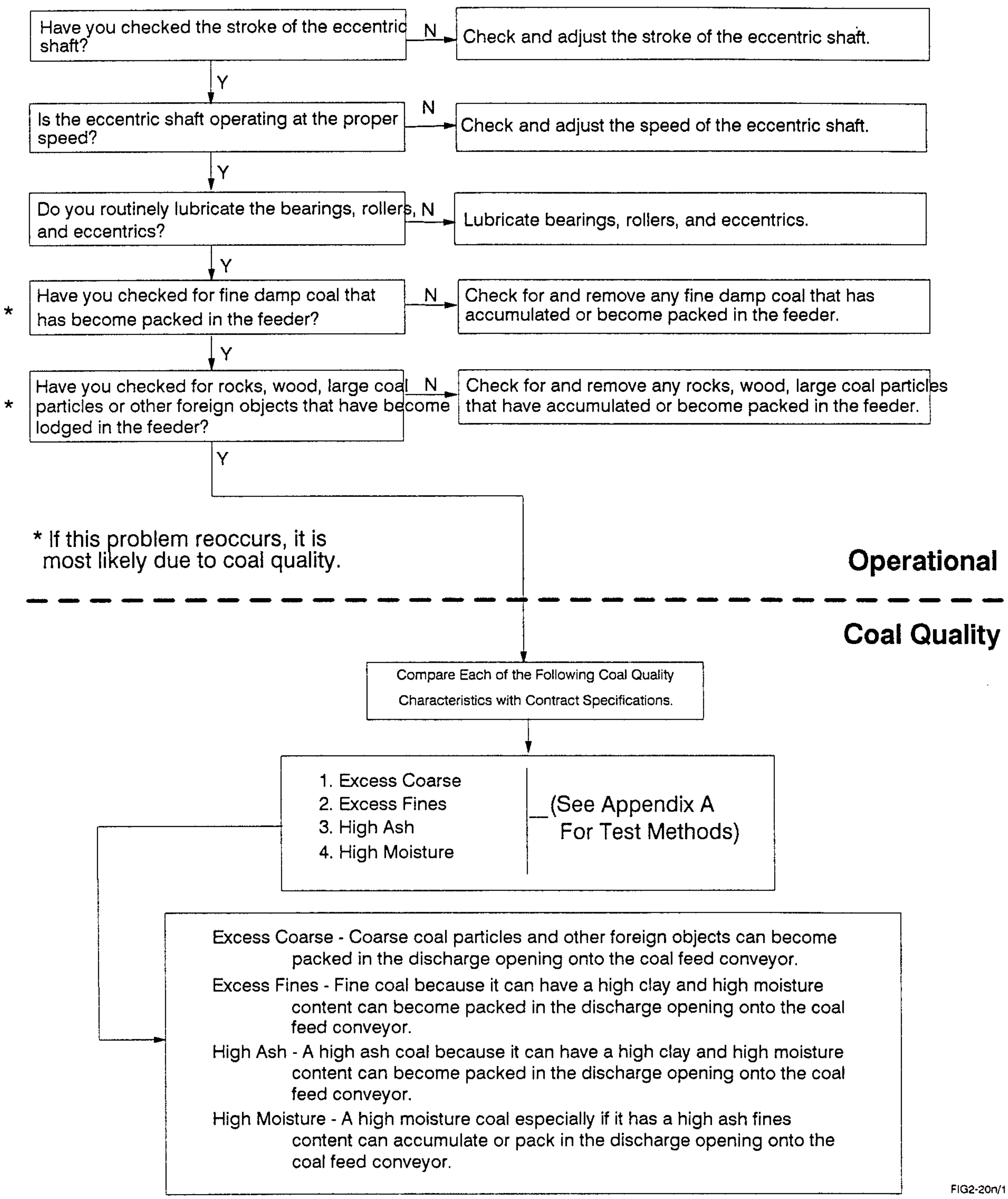


FIGURE 2-21: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Reciprocating Feeder)

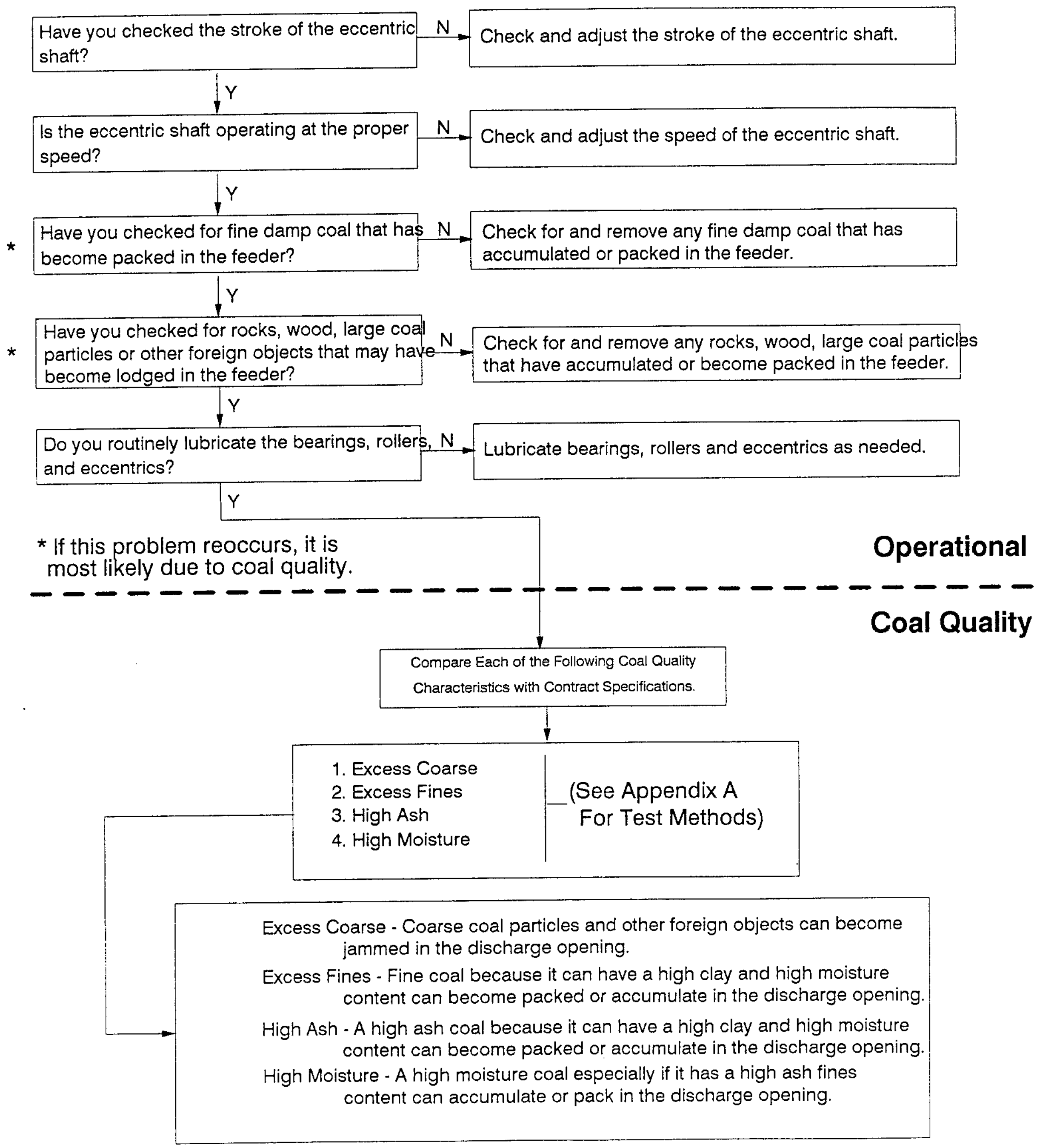


FIG2-21n/1

FIGURE 2-22: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Reciprocating Feeder)

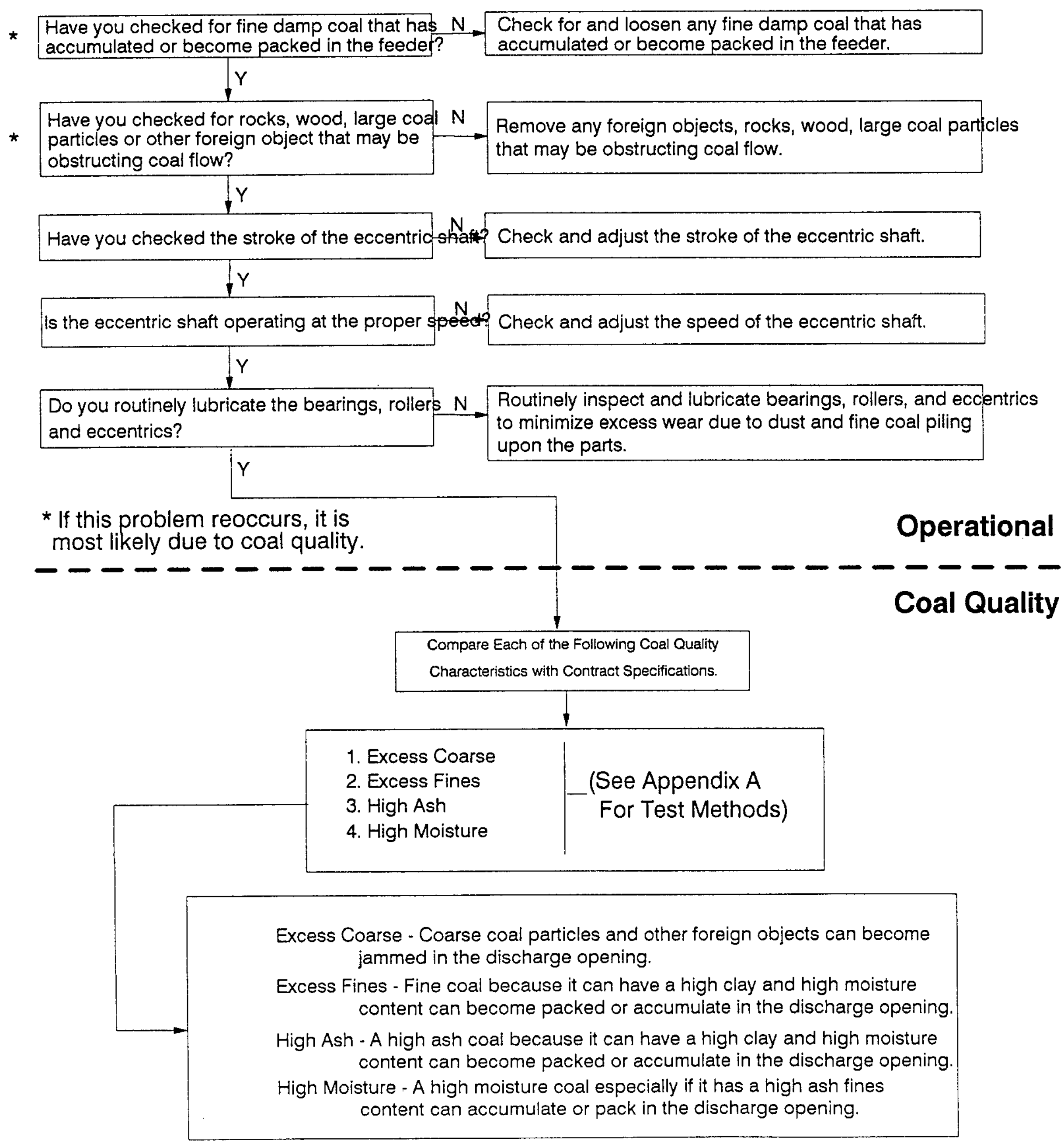


FIG2-22n/1

FIGURE 2-23: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Feed Conveyor (Belt Conveyor)

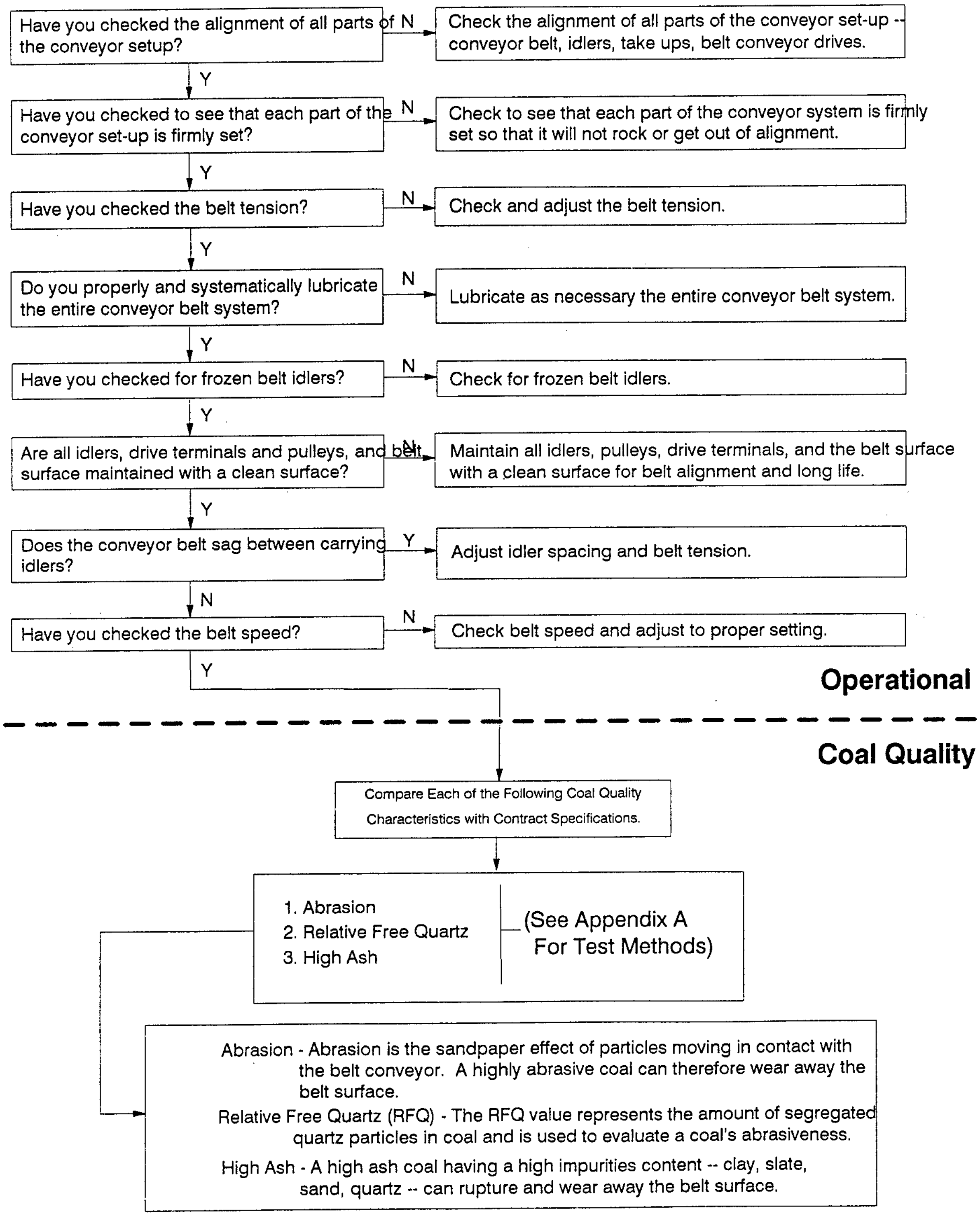


FIG2-23n/1

FIGURE 2-24: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor

(Belt Conveyor)

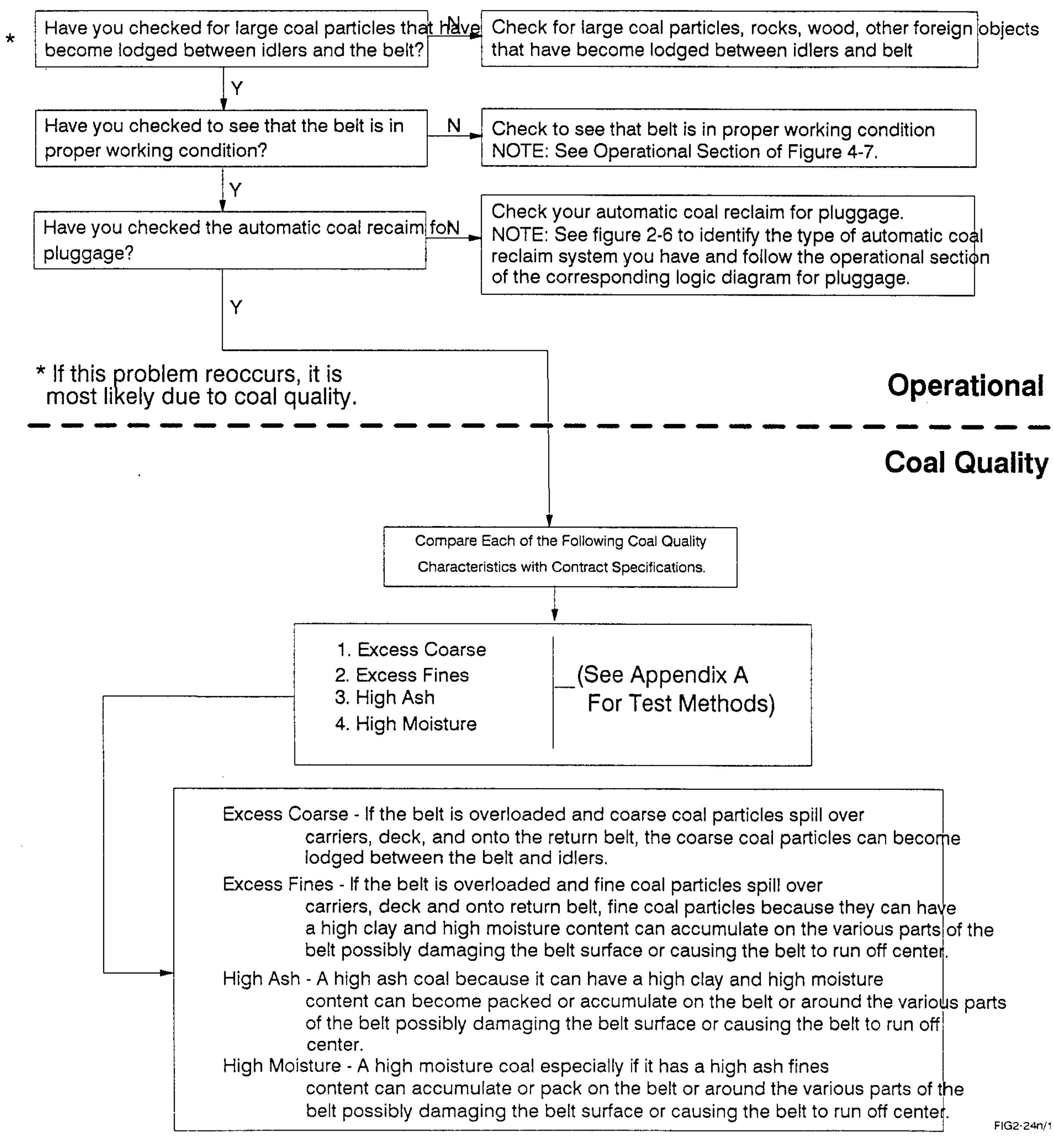


FIGURE 2-25: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Belt Conveyor)

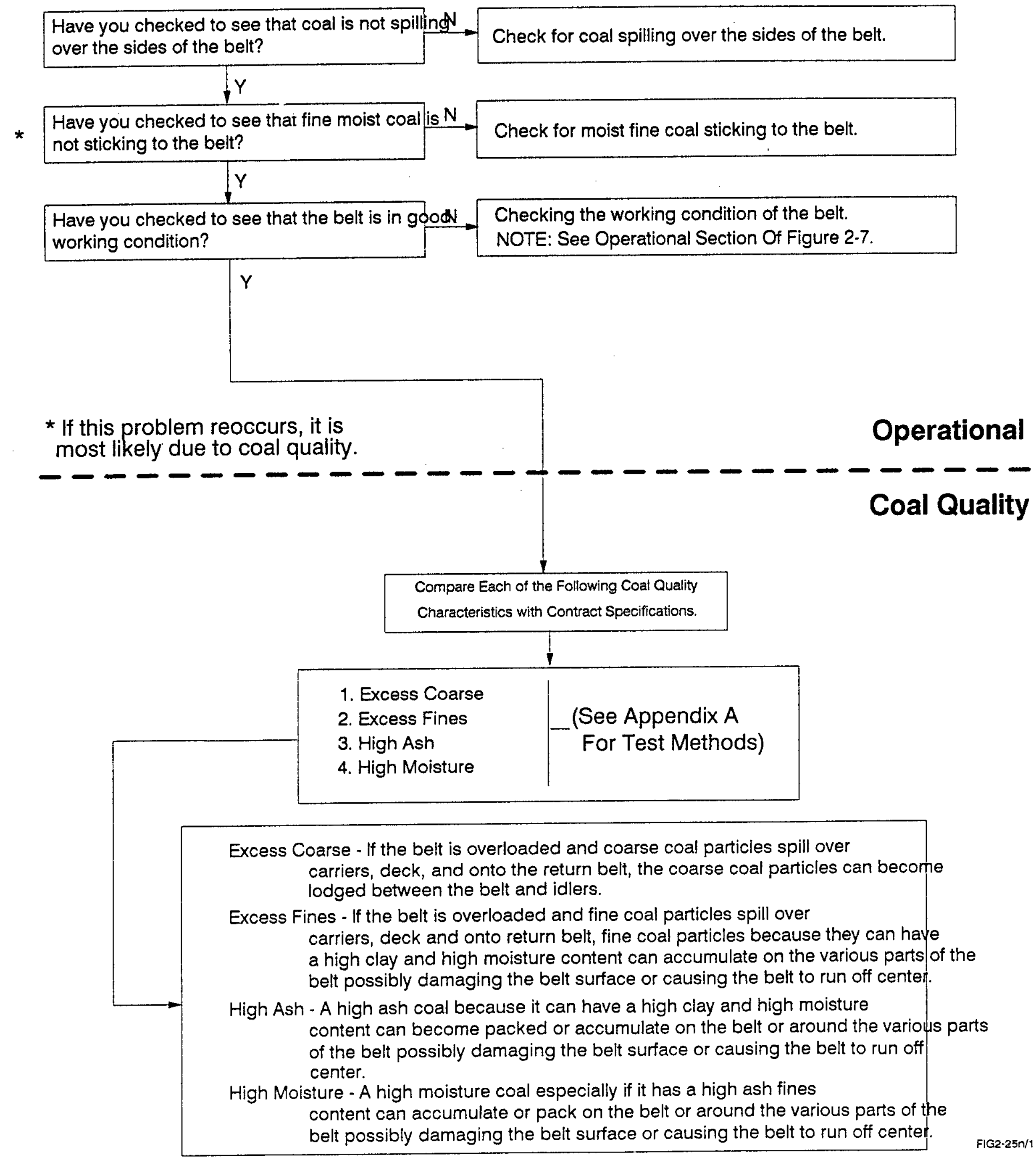


FIGURE 2-26: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor
(Belt Conveyor)

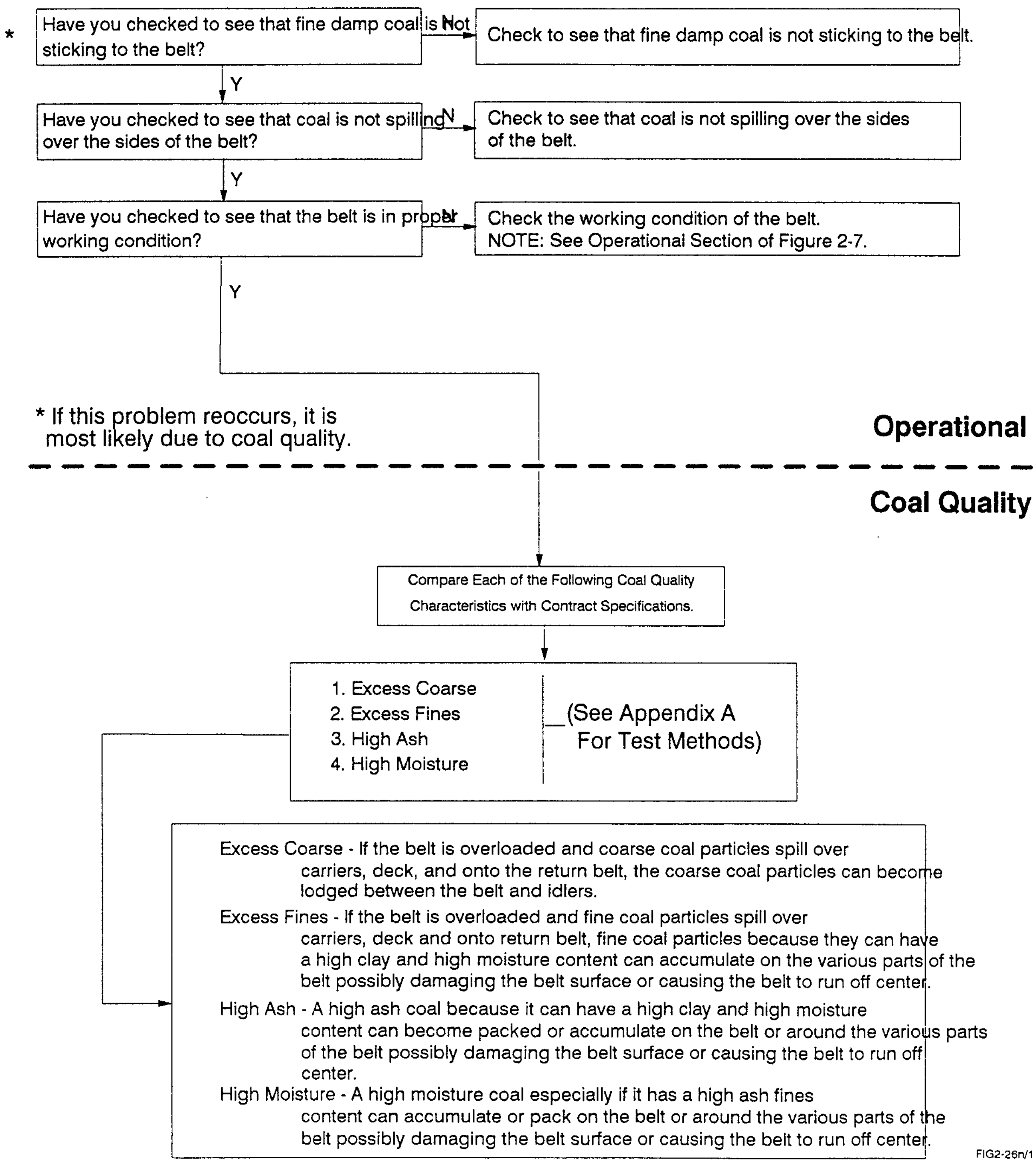


FIGURE 2-27: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
for Excess Wear In The Coal Feed Conveyor
(Screw Conveyor)

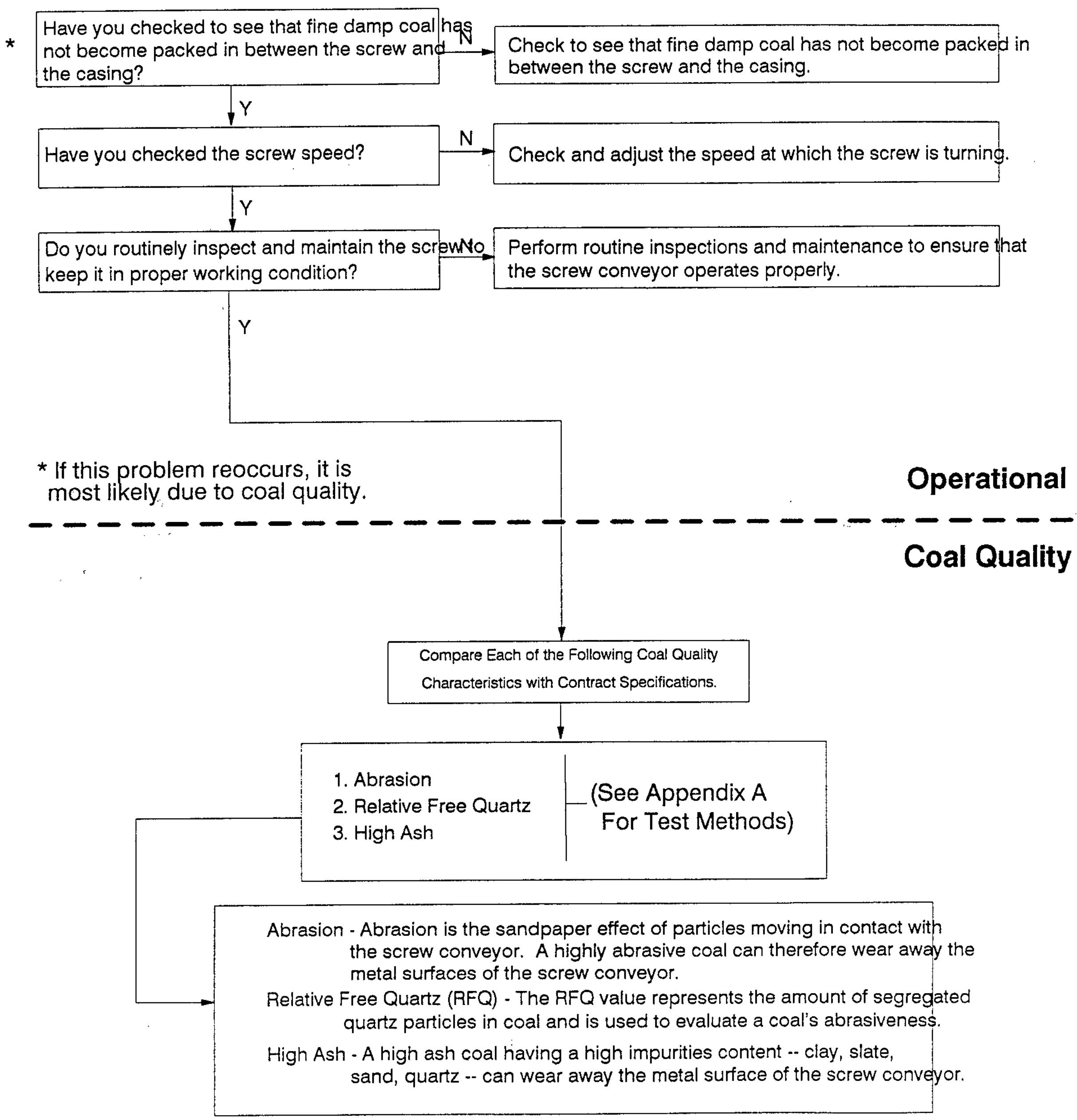


FIG2-27n/1

FIGURE 2-28: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Screw Conveyor)

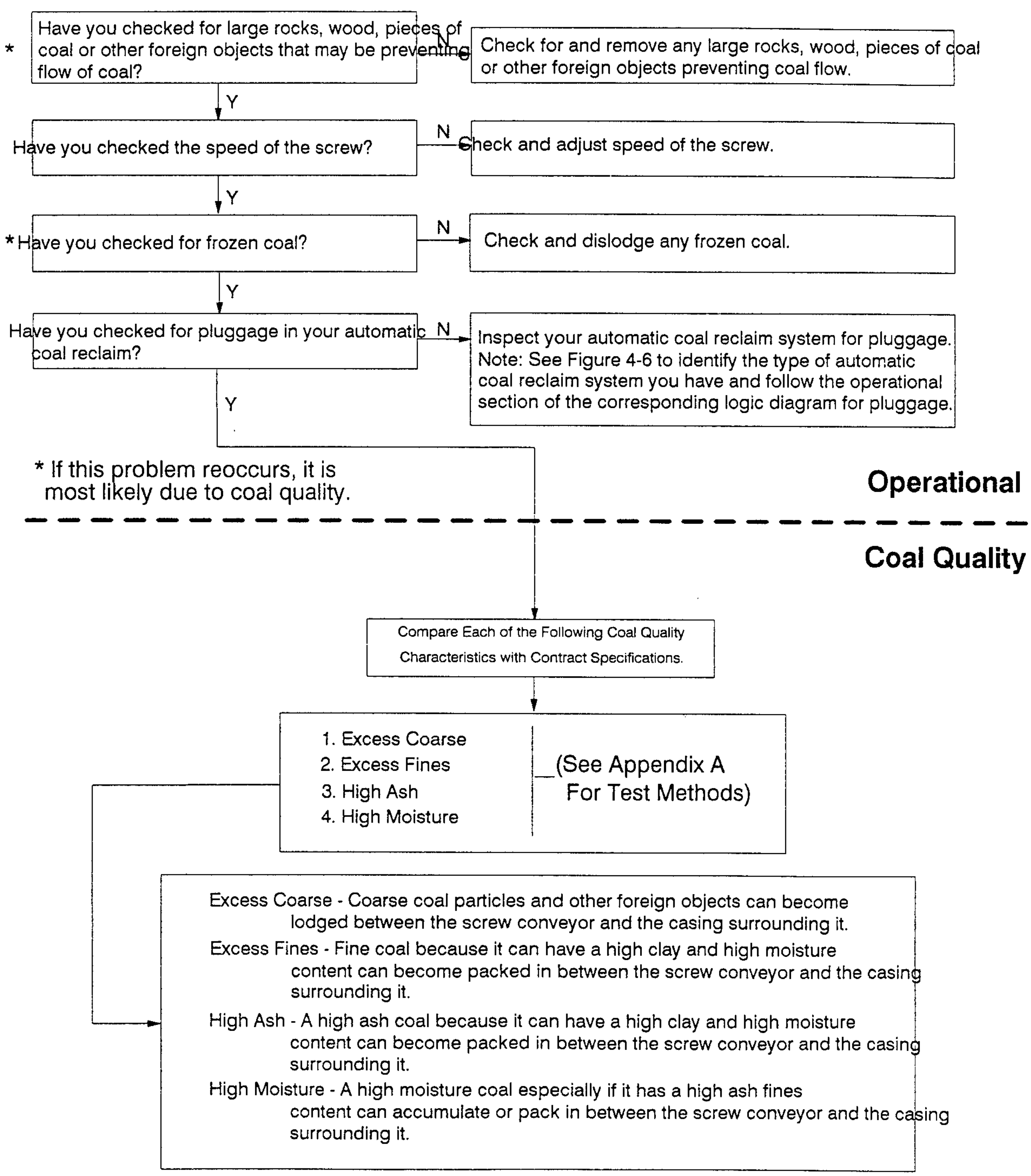


FIG2-28n/1

FIGURE 2-29: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Screw Conveyor)

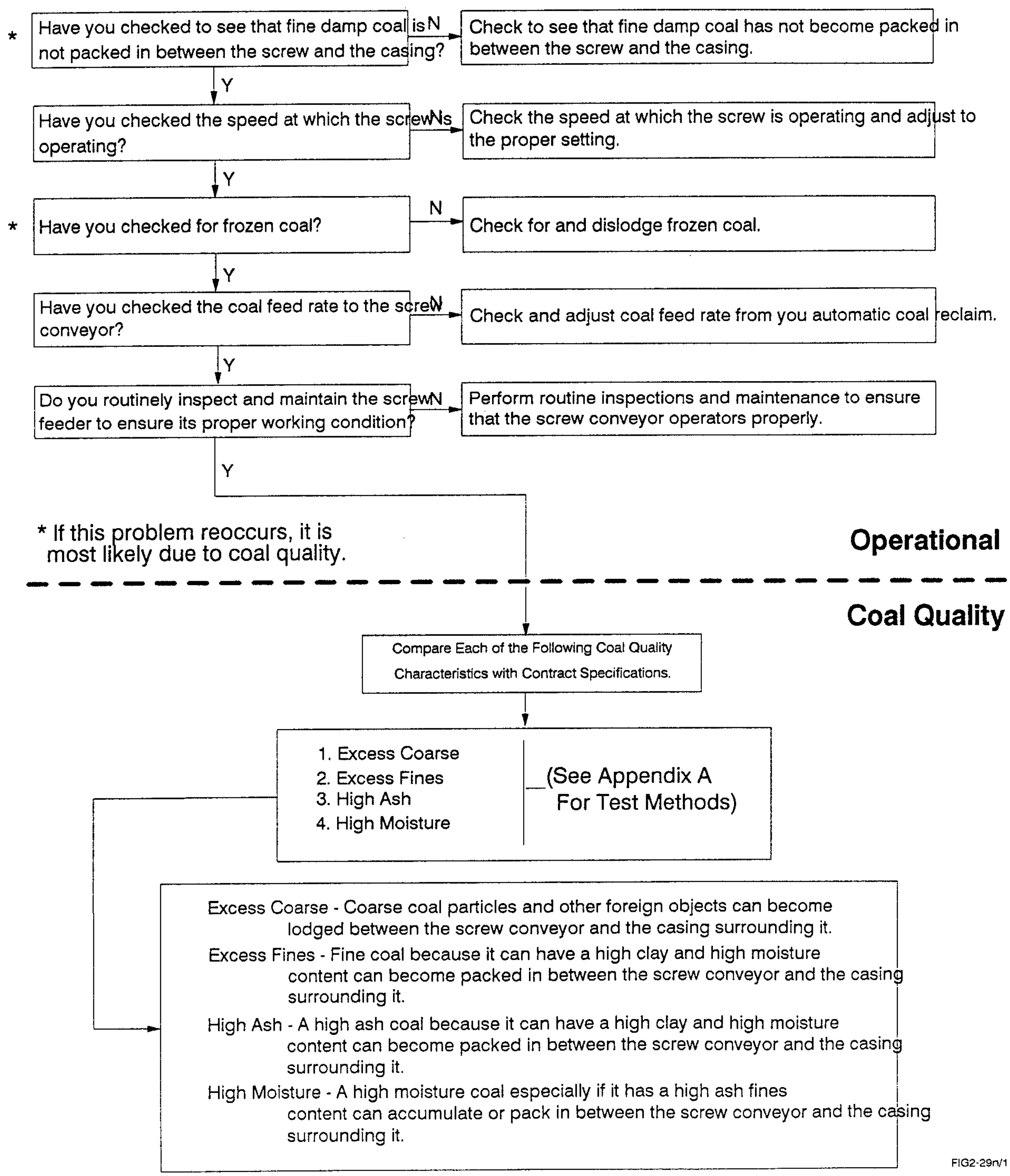


FIGURE 2-30: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor (Screw Conveyor)

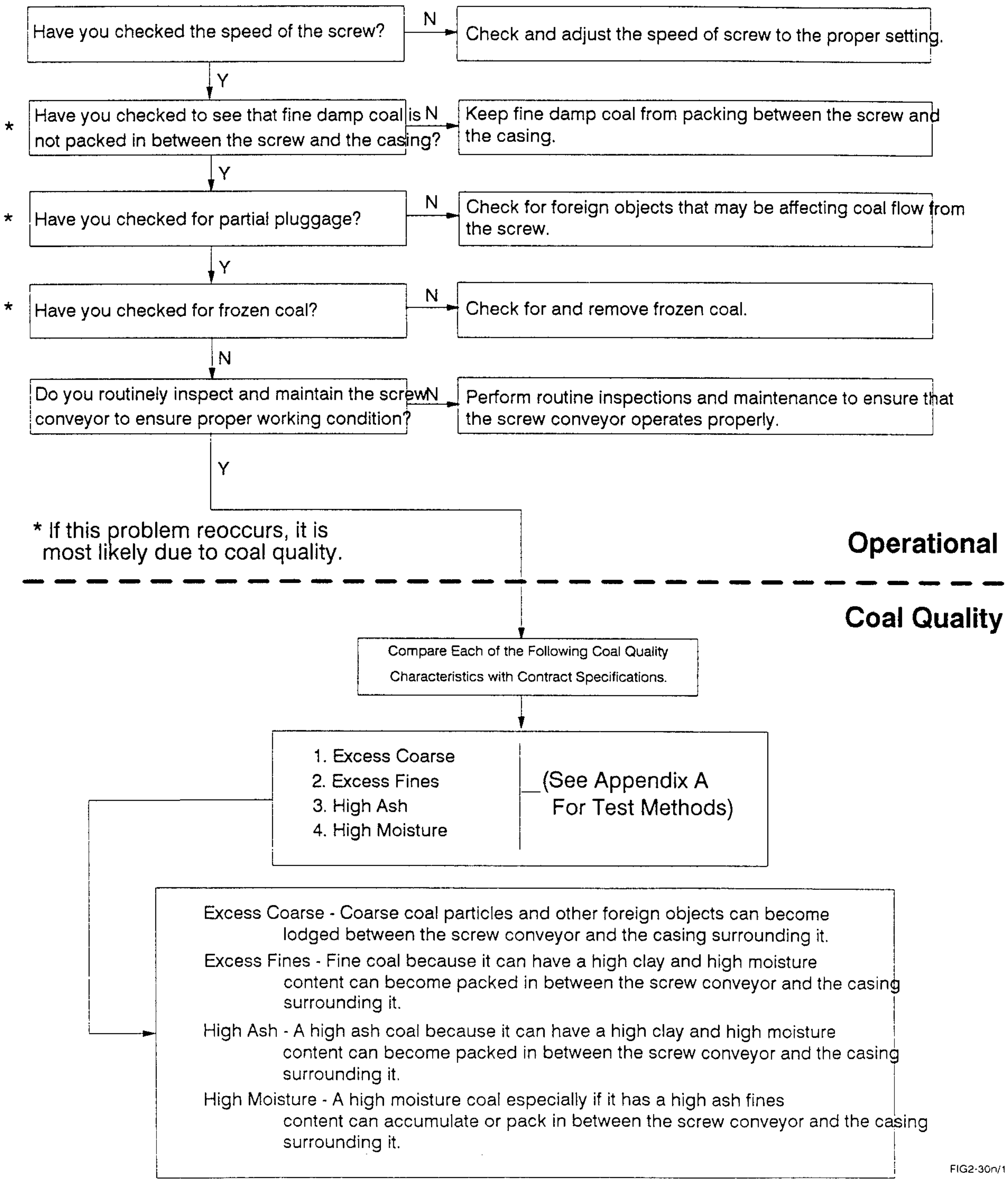


FIG2-30n/1

FIGURE 2-31: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor (Bucket Conveyor)

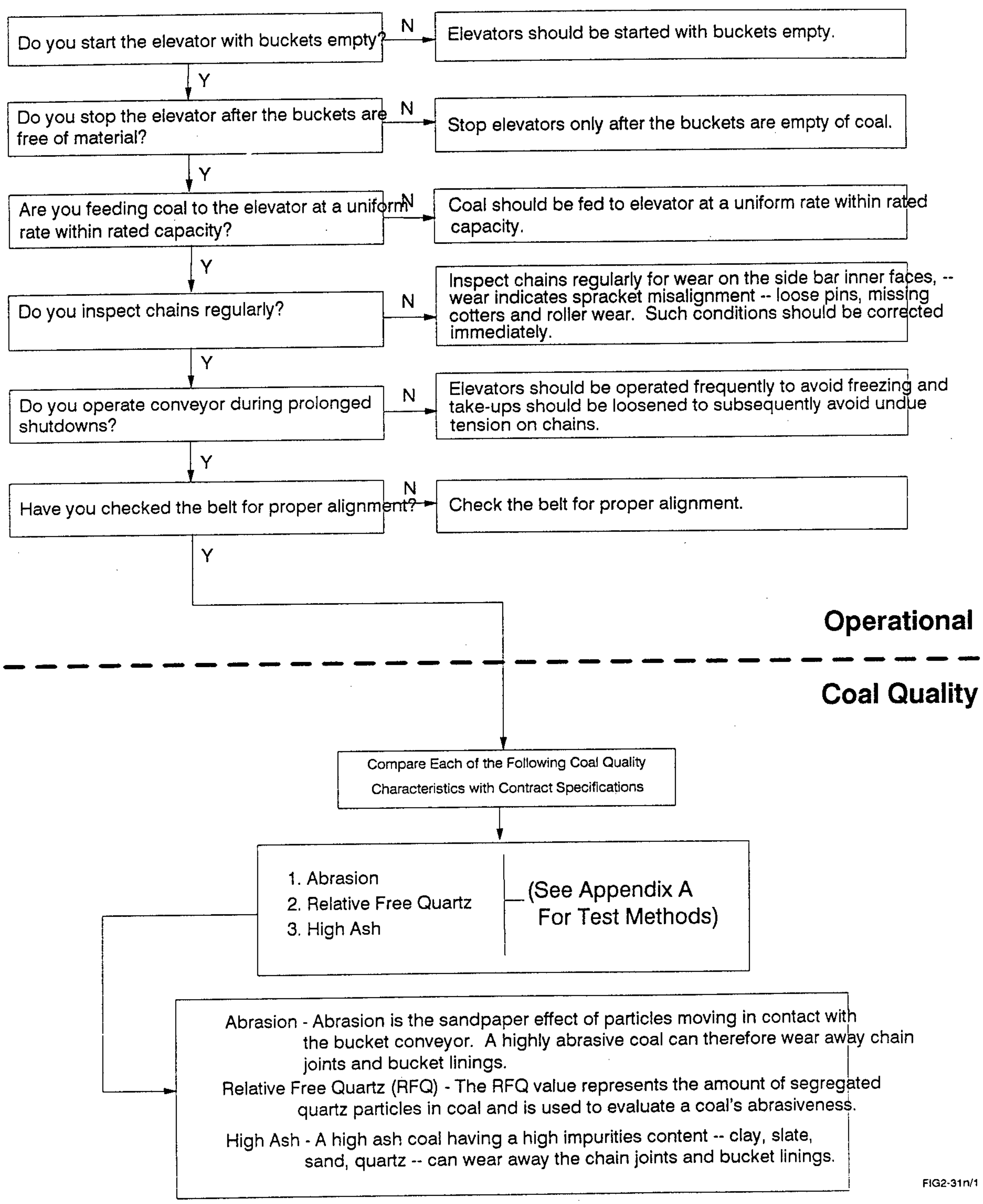


FIGURE 2-32: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Bucket Conveyor)

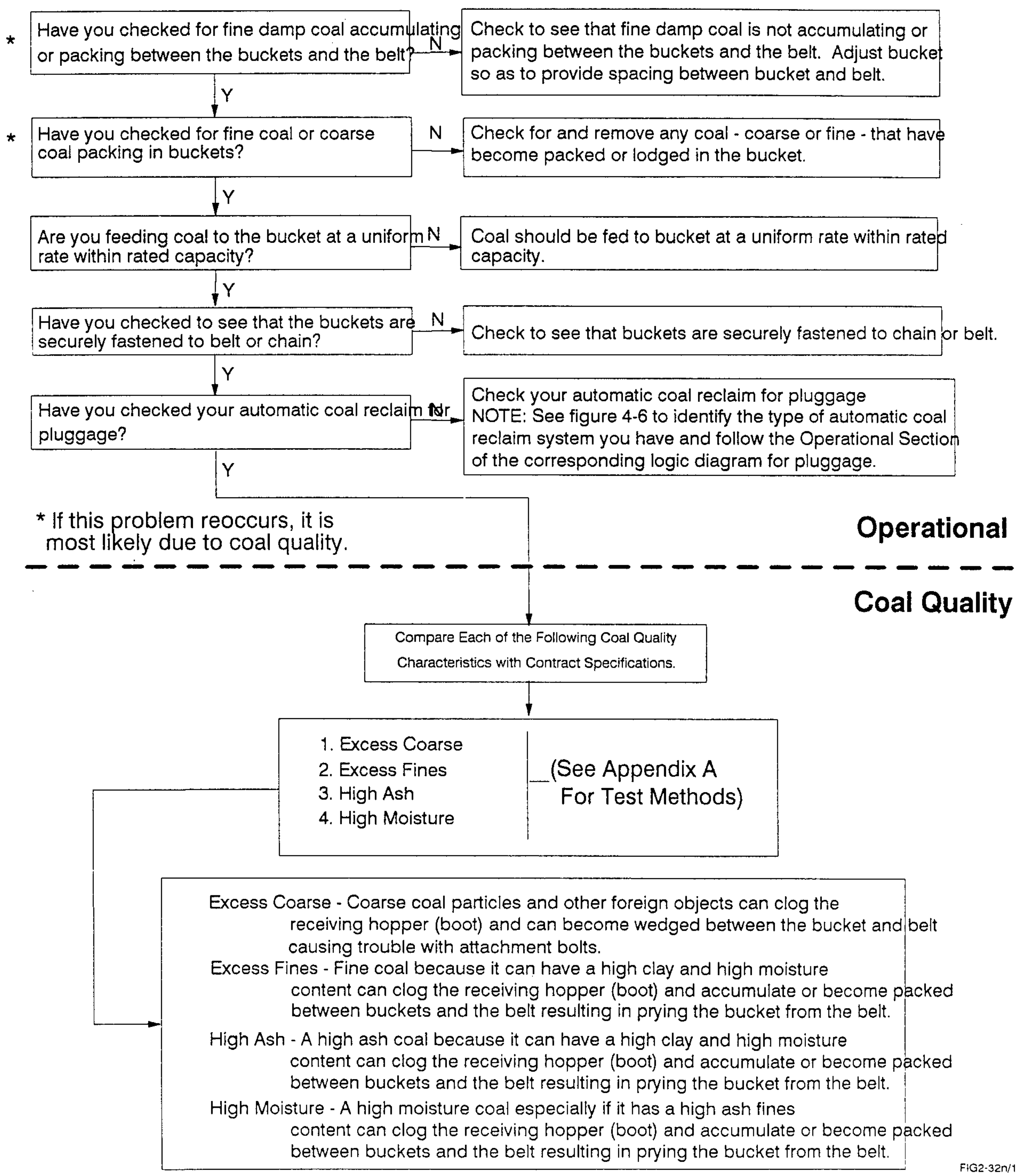


FIGURE 2-33: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Bucket Conveyor)

* Have you checked for fine damp coal accumulating or packing between the buckets and belt and in the buckets?

N → Check to see that fine damp coal is not accumulated or packing between the buckets and the belt and in buckets. Adjust bucket so as to provide spacing between bucket and belt.

Y ↓

Are you feeding coal to the buckets at a uniform rate within rated capacity?

N → Coal should be fed to buckets at a uniform rate within rated capacity.

Y ↓

Have you checked to see that the buckets are securely fastened to chain or belt?

N → Check to see that buckets are securely fastened to chain or belt.

Y ↓

Have you checked the belt for proper alignment?

N → Check to see that the belt is in alignment with the idlers.

Y ↓

Are you missing any buckets?

N → Inspect conveyor and replace any worn or missing brackets.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become wedged between the bucket and belt causing trouble with attachment bolts.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

FIG2-33n/1

FIGURE 2-34: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

Erratic Feeding From The Coal Feed Conveyor (Bucket Conveyor)

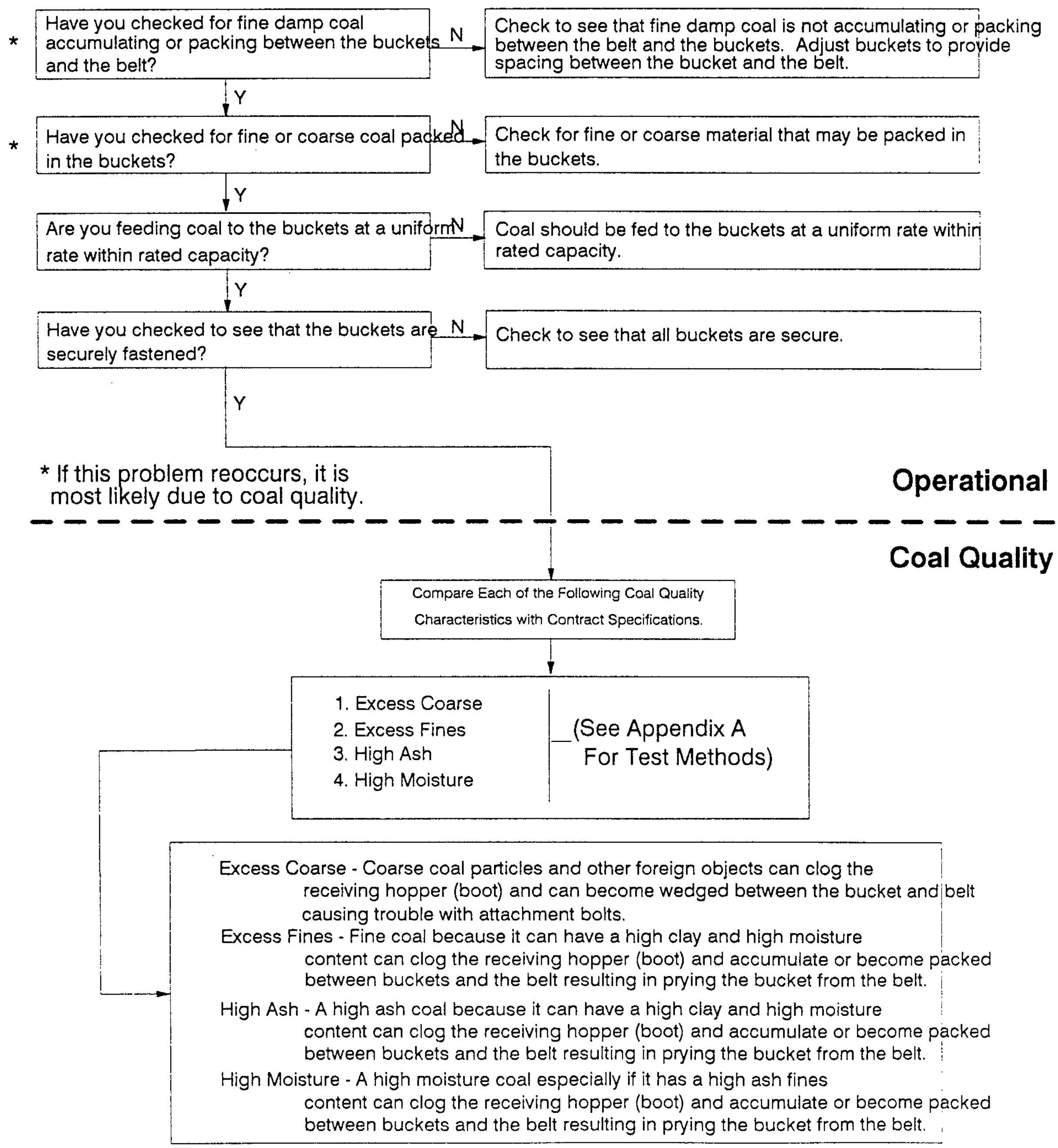


FIG2-34n/1

FIGURE 2-35: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of Coal Feed Conveyors (Redler Conveyors)

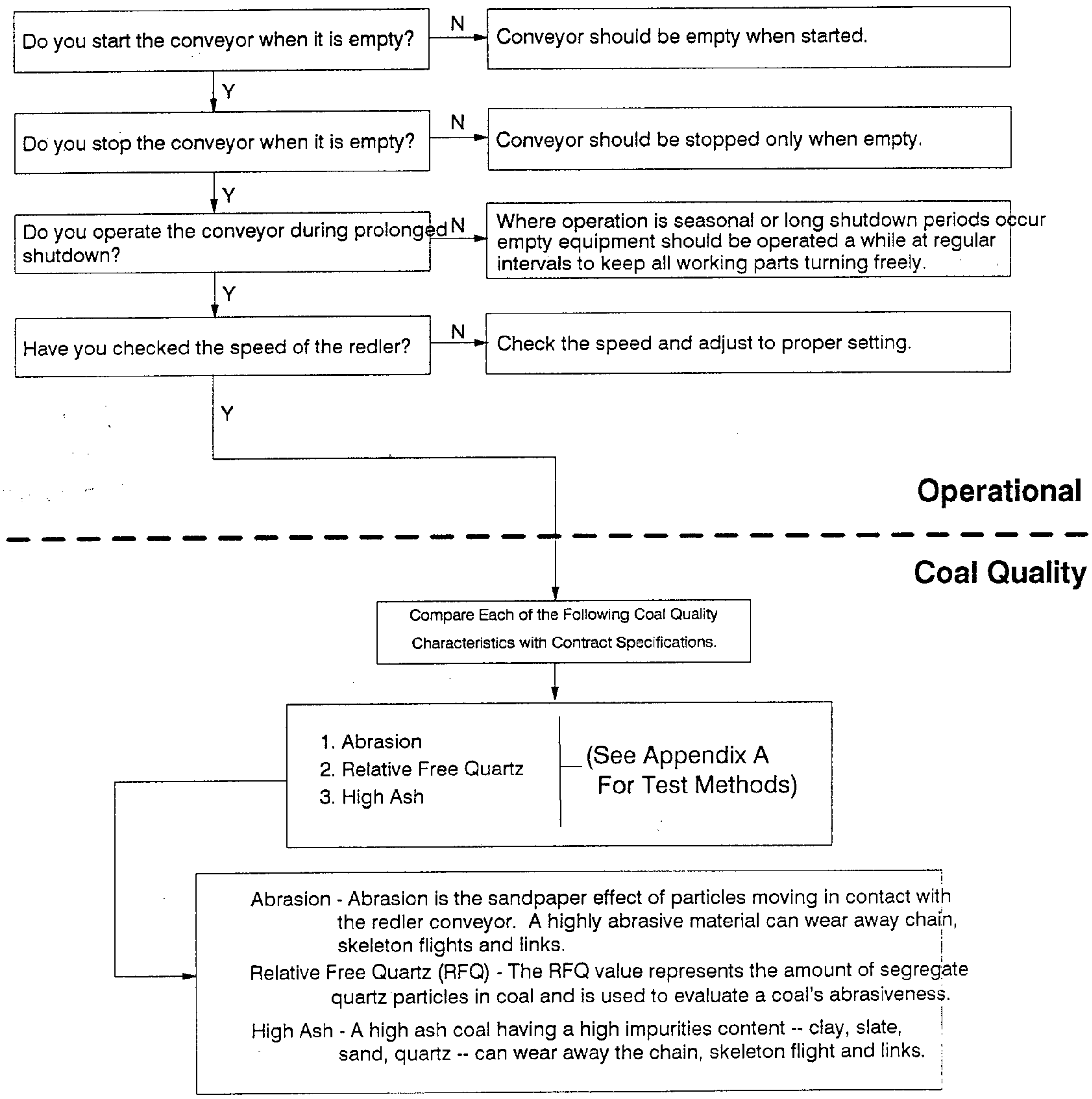


FIG2-35n/1

FIGURE 2-36: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor
(Redler Conveyor)

* Have you checked to see that fine damp coal has not become packed between the skeleton flights?
- N → Check to see that fine damp coal has not become packed between the skeleton flights.
- Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
- N → Check to see that coal is being fed at a uniform rate within rated capacity.
- Y ↓

* Have you checked to see that coarse material -- rocks, wood, -- have not become lodged between the duct and the skeleton flight chain?
- N → Check to see that coarse material -- rocks, wood, etc.-- have not become lodged between the duct or tube and the skeleton flight chain.
- Y ↓

Have you checked your automatic coal reclaim for pluggage?
- N → Check your automatic coal reclaim for pluggage. NOTE: See figure 4-6 to identify the type of automatic coal reclaim system you have and follow the Operational Section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG2-36n/1

FIGURE 2-37: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Coal Feed Conveyor (Redler Conveyor)

* Have you checked for fine damp coal that has become packed in between the skeleton flights?
N → Check to see that fine damp coal has not become packed between skeleton flights.
Y ↓

* Have you checked to see that coarse material - rocks, wood, frozen coal - has not become lodged between the duct and the skeleton flight?
N → Check to see that coarse material -- rocks, wood, frozen coal -- has not become lodged between the duct and the skeleton flights.
Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
N → Check to see that coal is being fed at a uniform rate within rated capacity.
Y ↓

Have you checked the speed of the redler?
N → Check the speed and adjust to the proper setting.
Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG2-37n/1

FIGURE 2-38: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor
(Redler Conveyor)

* Have you checked that fine damp coal has not become packed between the skeleton flights?

N → Check to see that fine damp coal has not become packed between skeleton flights.

Y

* Have you checked to see that rocks, wood, large coal particles have not become lodged between the duct and the skeleton flights?

N → Check to see that rocks, wood, large coal particles have not become lodged between duct and skeleton flights.

Y

Have you checked to see that the coal is being fed at a uniform rate within rated capacity?

N → Check to see that coal is being fed at a uniform rate within rated capacity.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG2-38n/1

FIGURE 2-39: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Chutes)

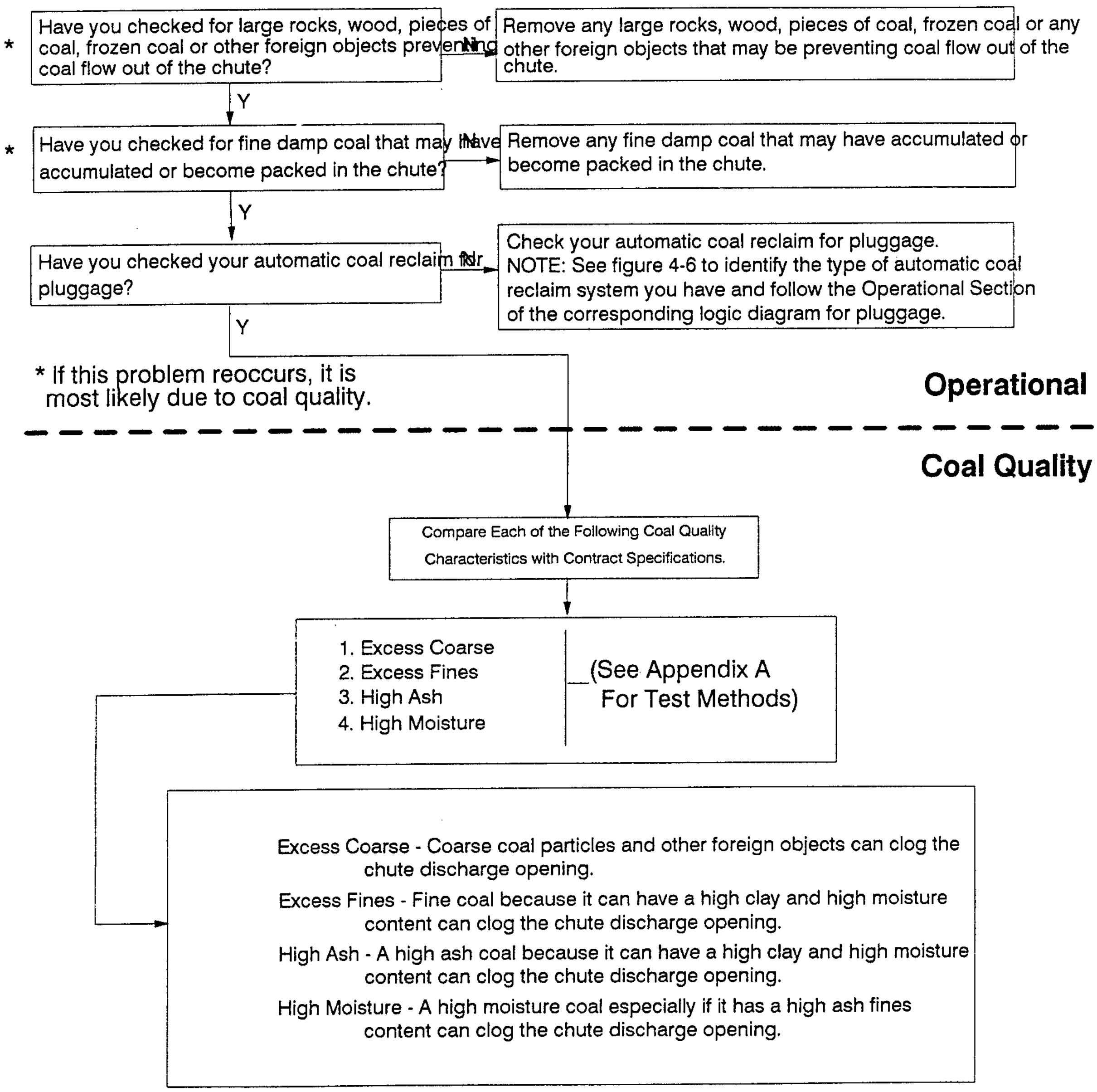


FIG2-39n/1

FIGURE 2-40: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Chutes)

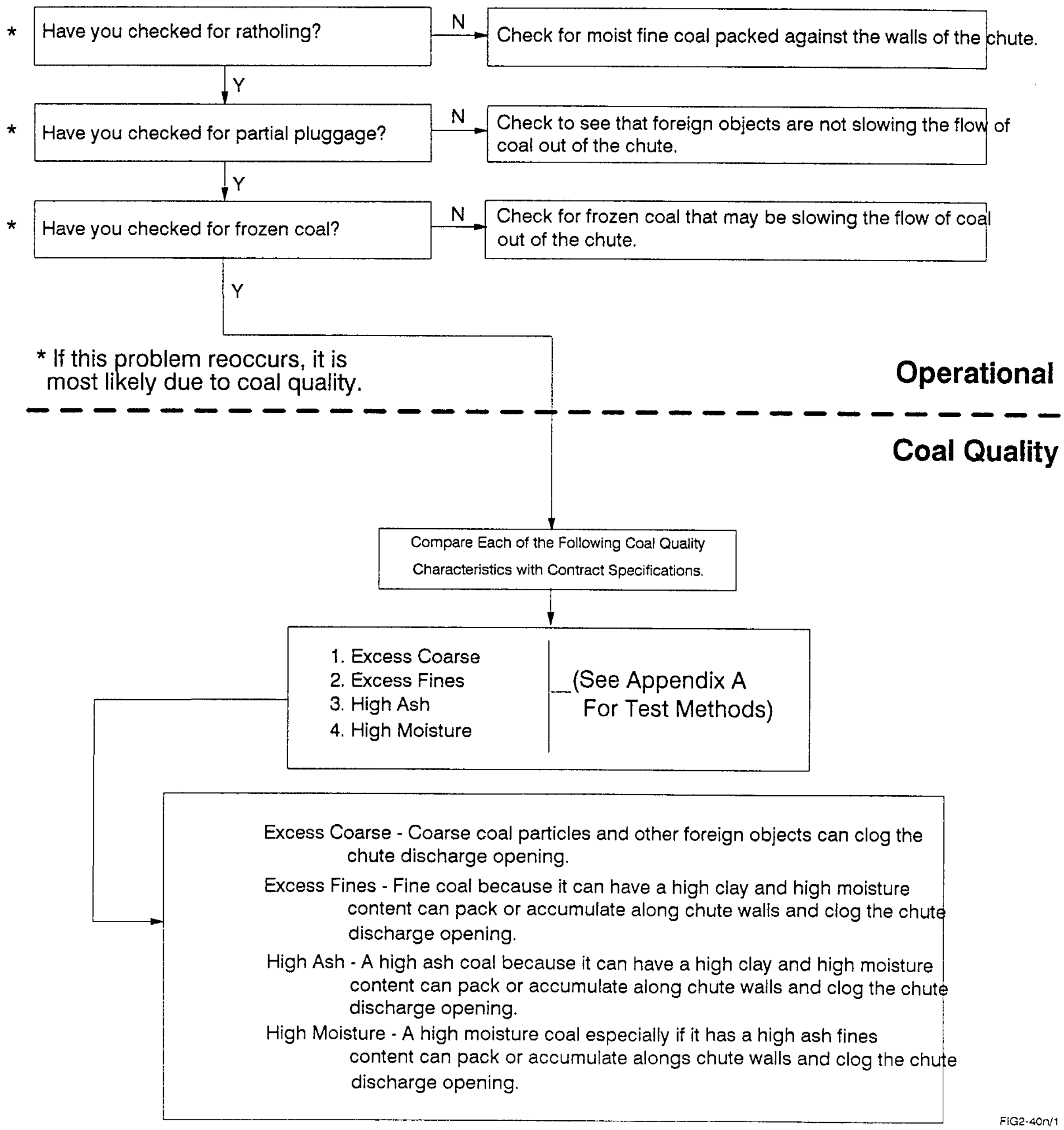


FIGURE 2-41: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Chute)

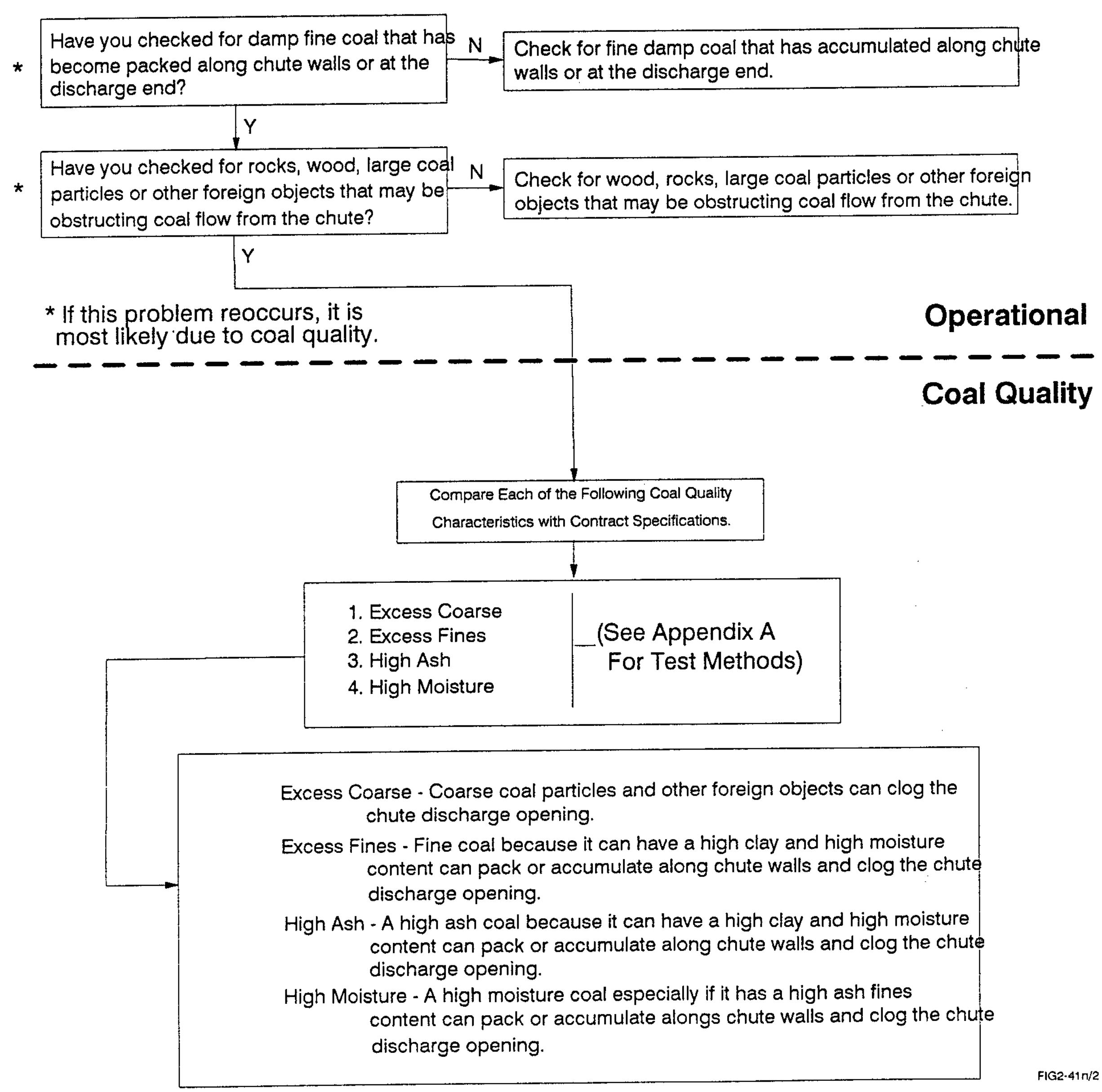


FIG2-41n/2

FIGURE 2-42: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feeders

(Chute)

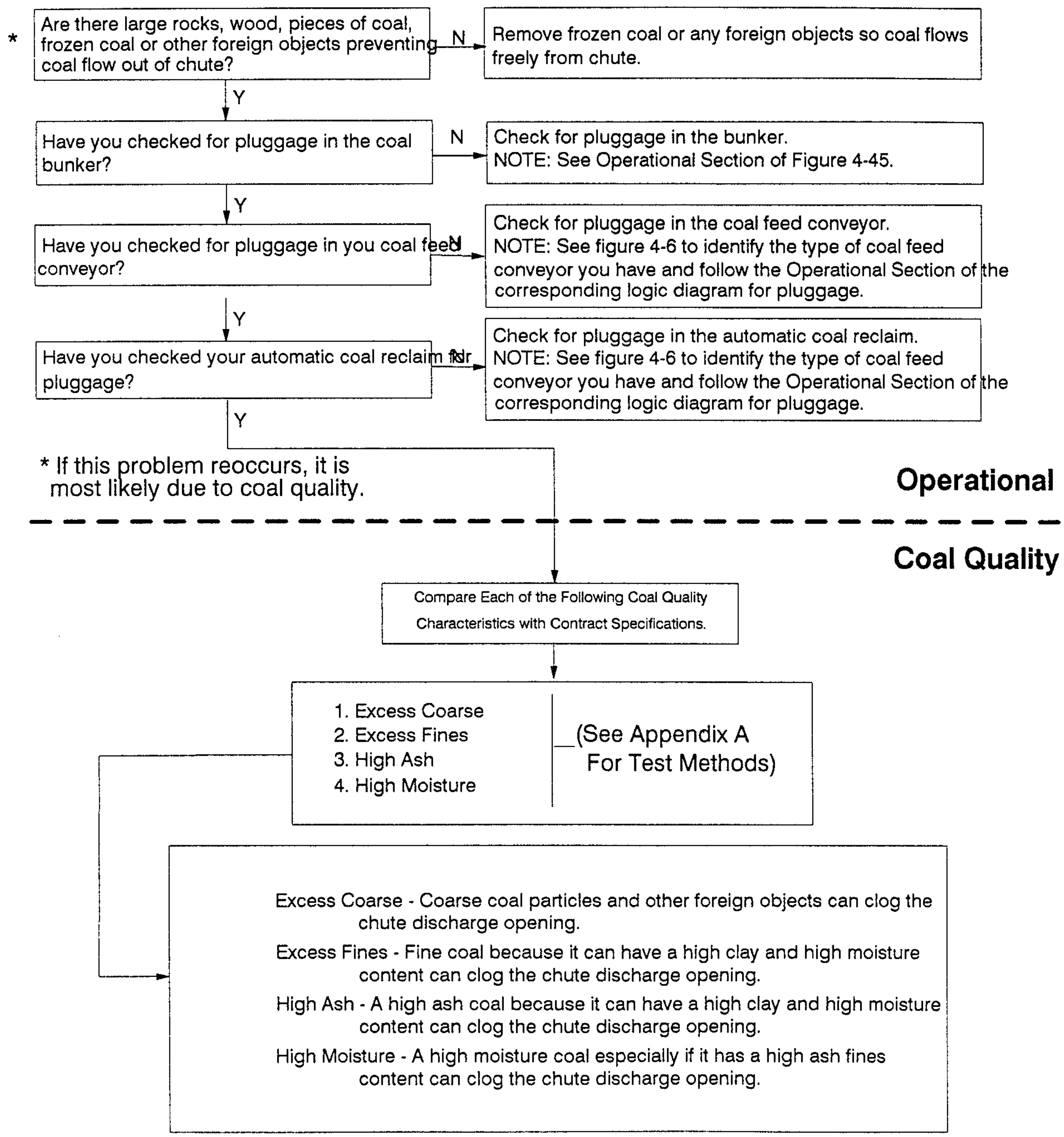


FIG2-42n/2

FIGURE 2-43: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In the Coal Feeder
(Chutes)

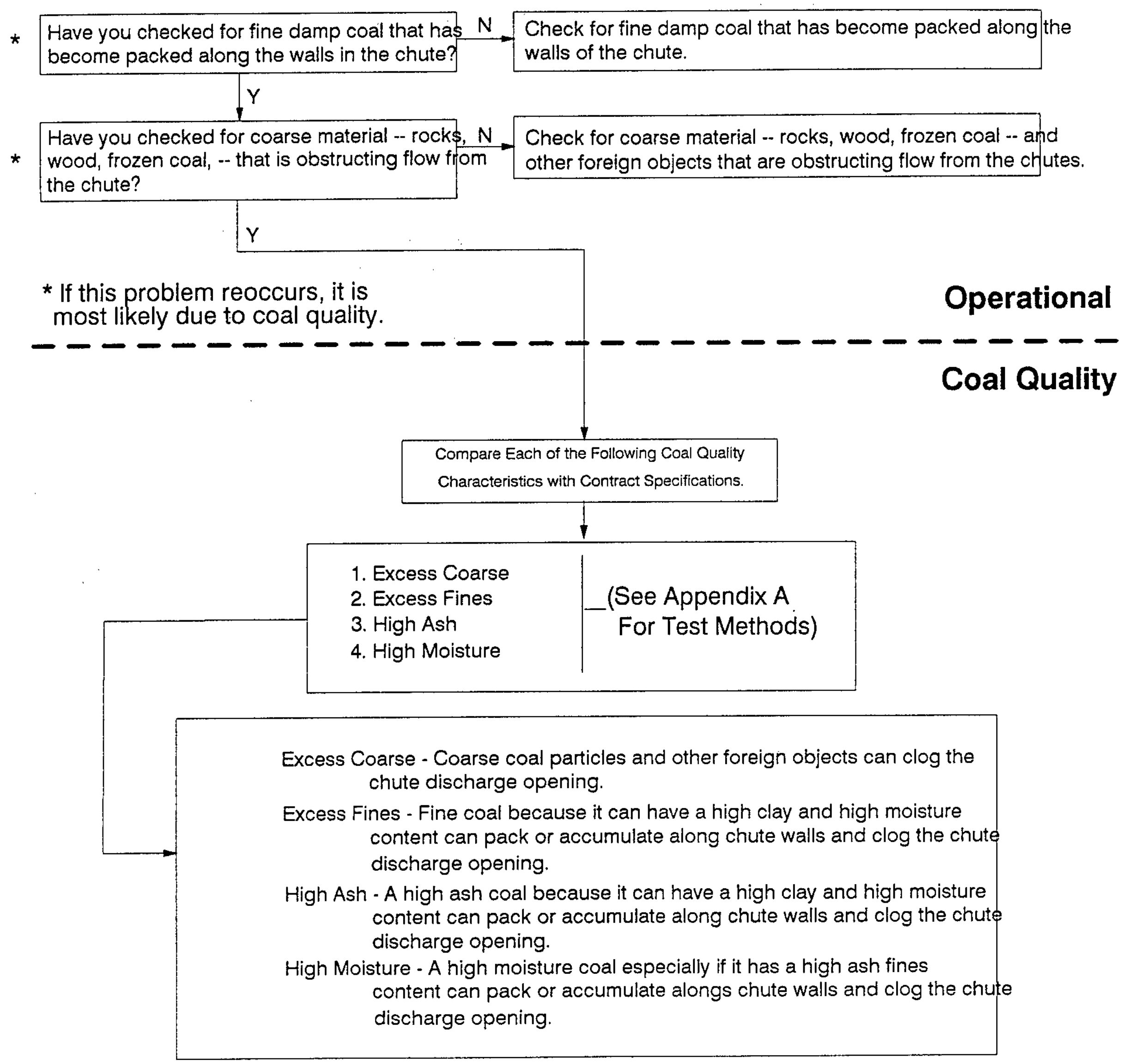


FIG2-43n/2

FIGURE 2-44: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feeder

(Chutes)

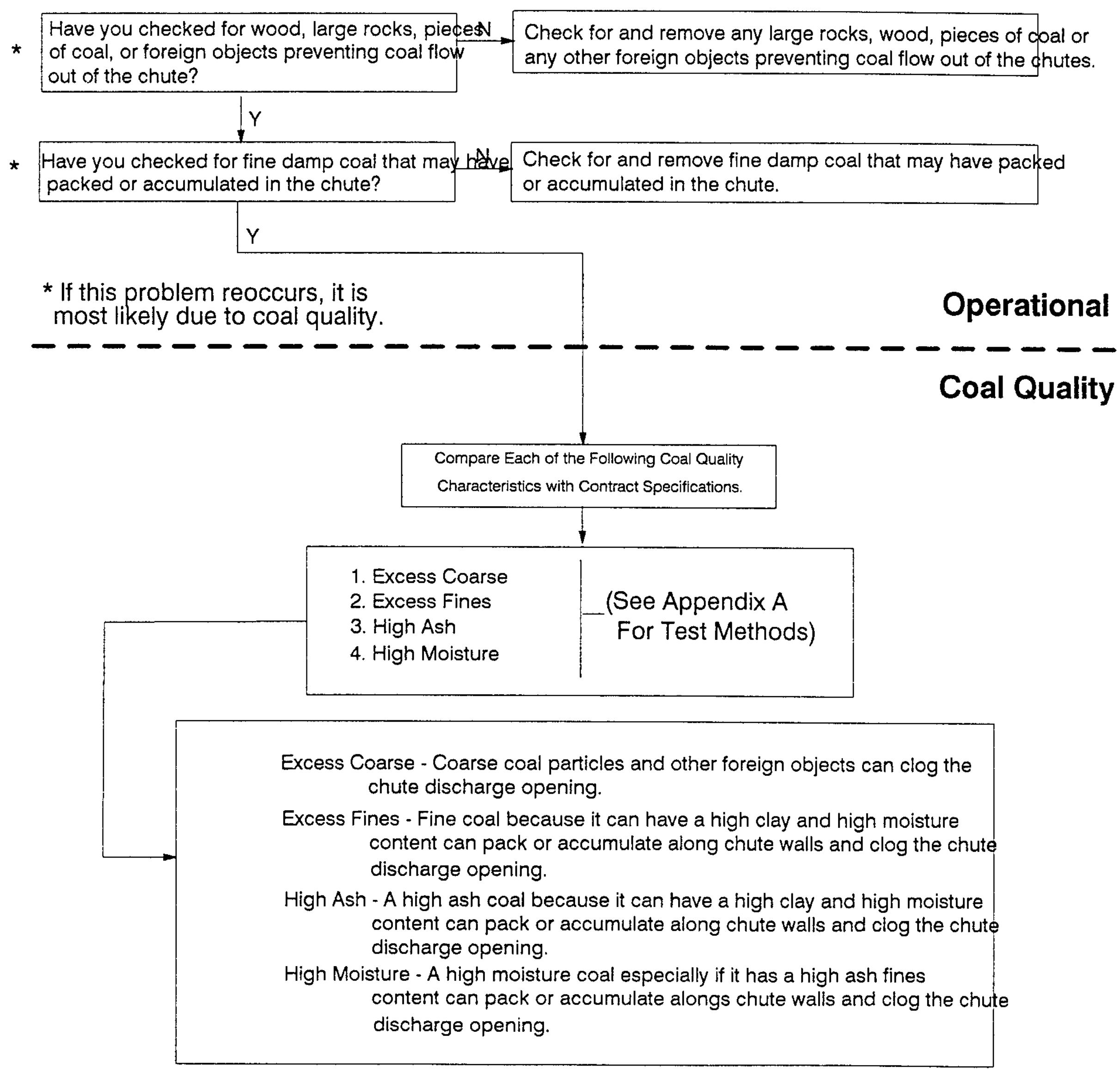


FIG2-44n/2

FIGURE 2-45: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Bunker

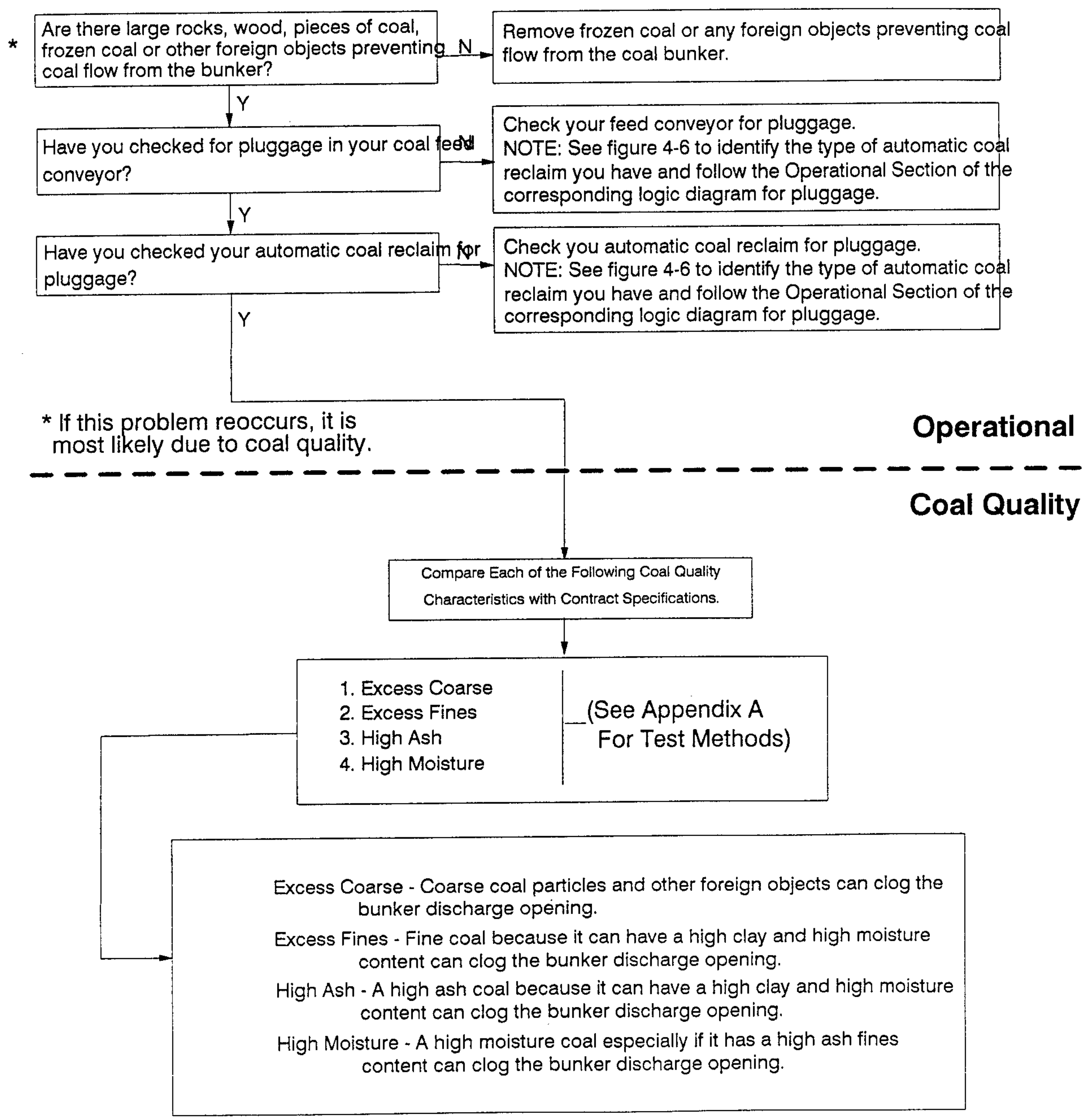


FIG2-45n/2

FIGURE 2-46: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Bunker

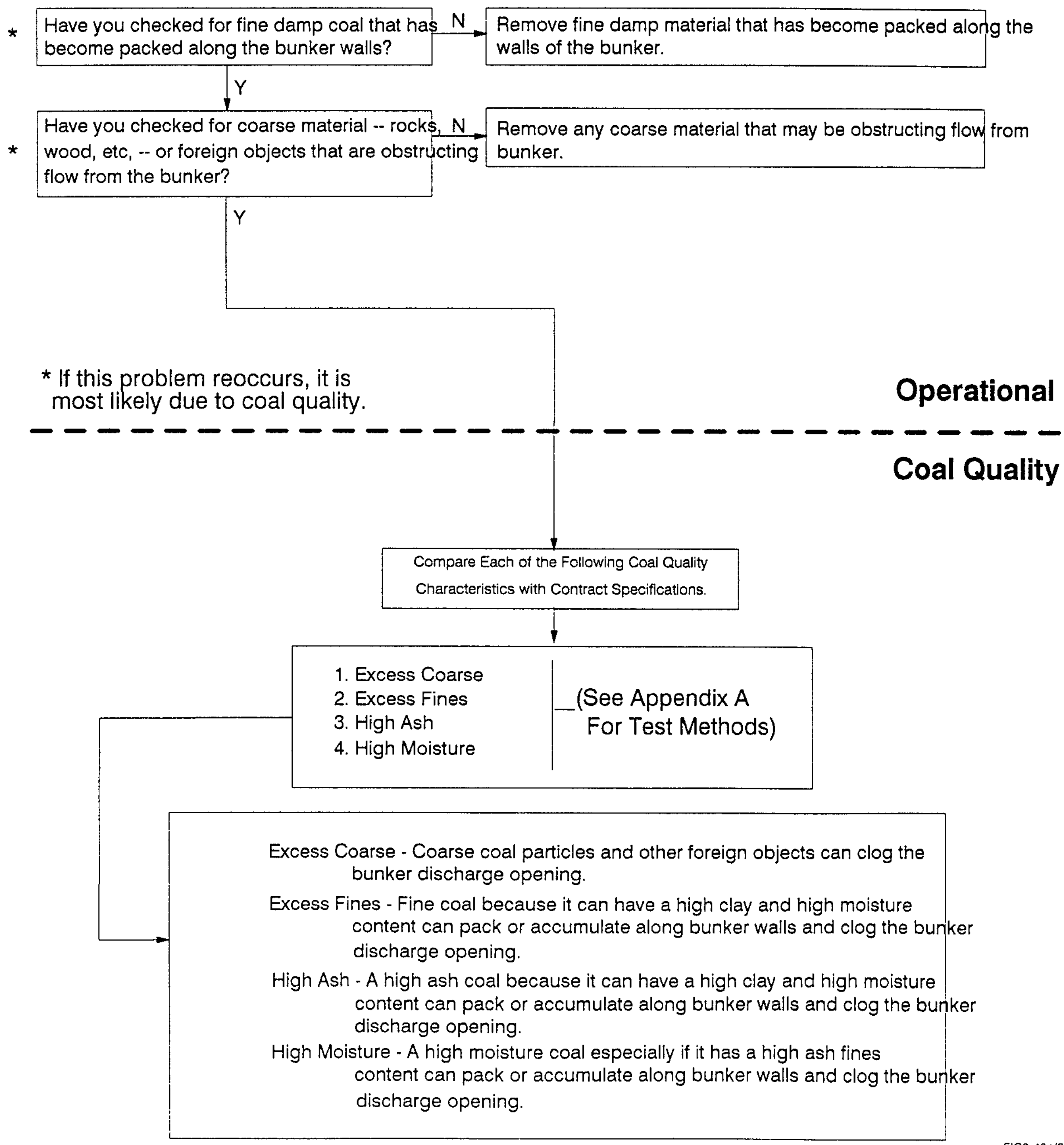


FIG2-46n/2

FIGURE 2-47: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Bunker

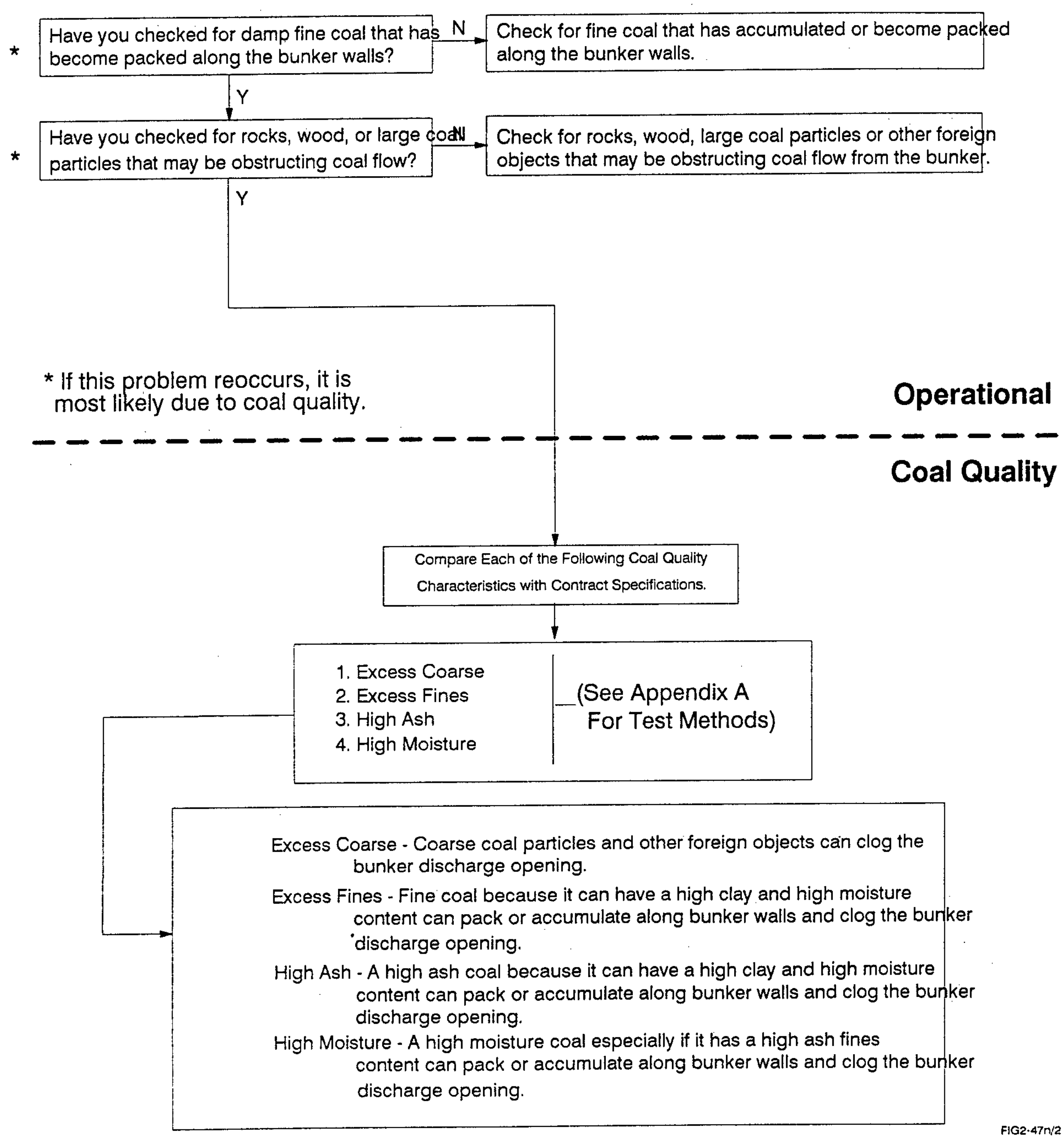


FIG2-47n/2

FIGURE 2-48: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Hopper

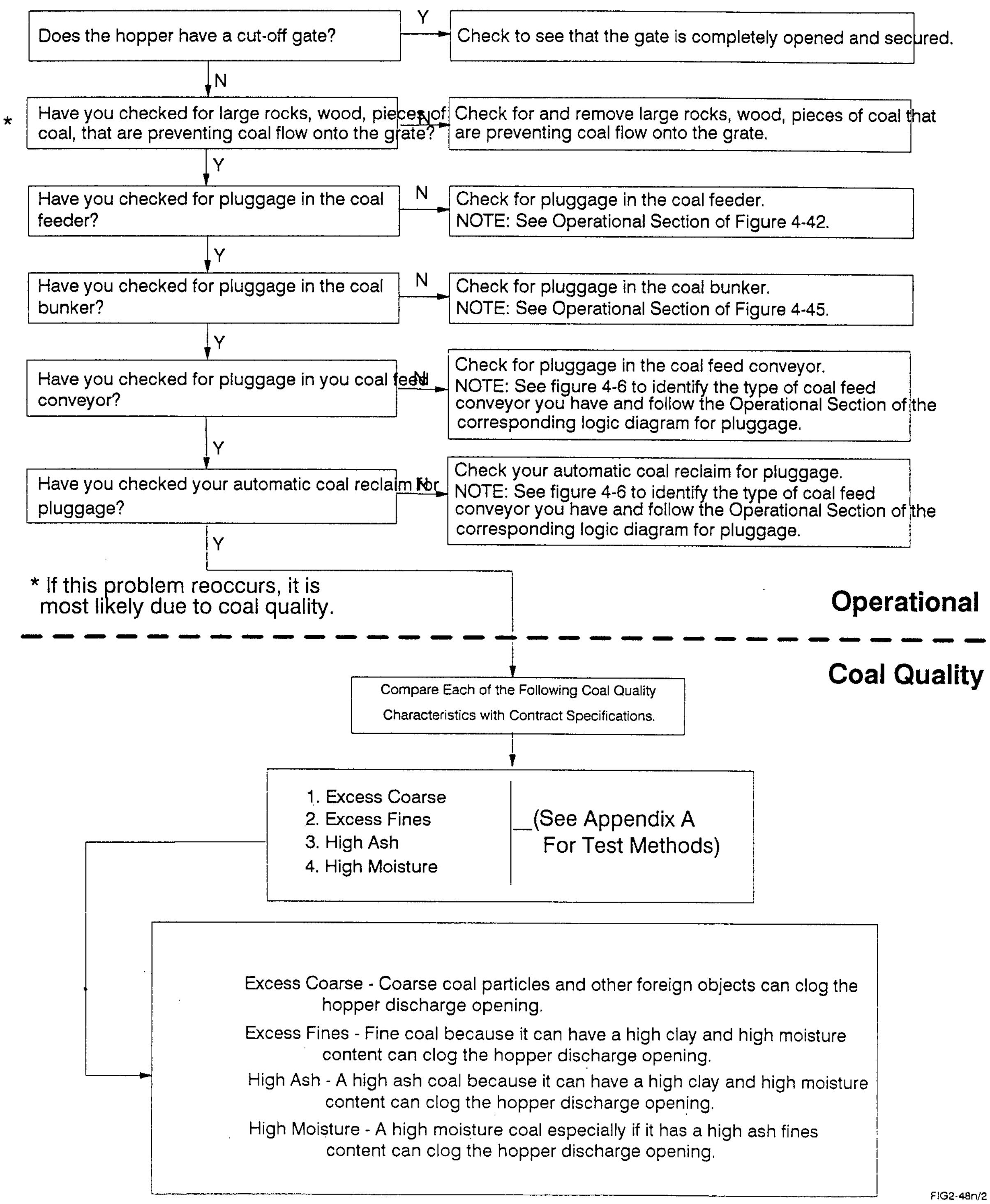


FIG2-48n/2

FIGURE 2-49: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

Insufficient Capacity In The Coal Hopper

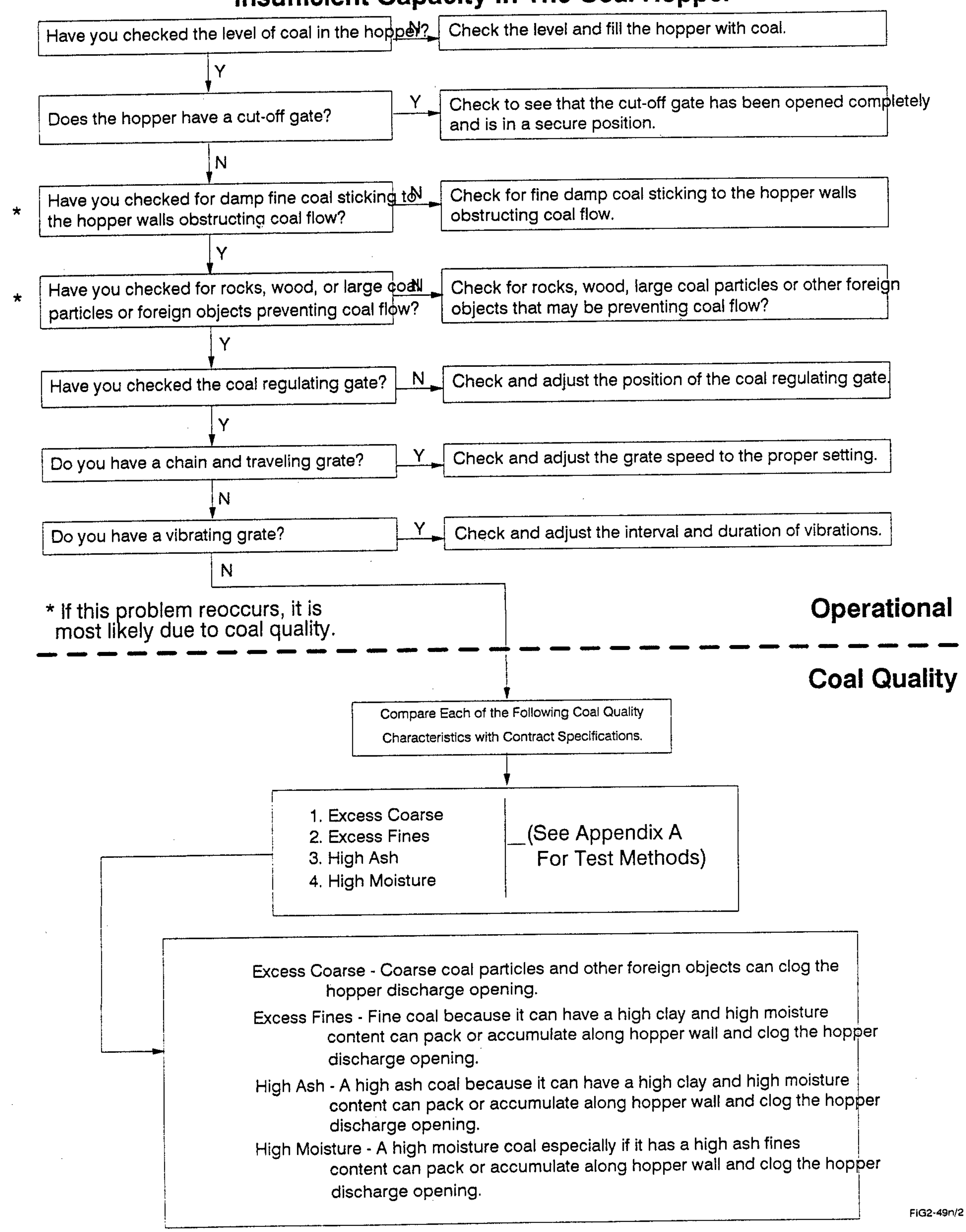


FIGURE 2-50: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Hopper

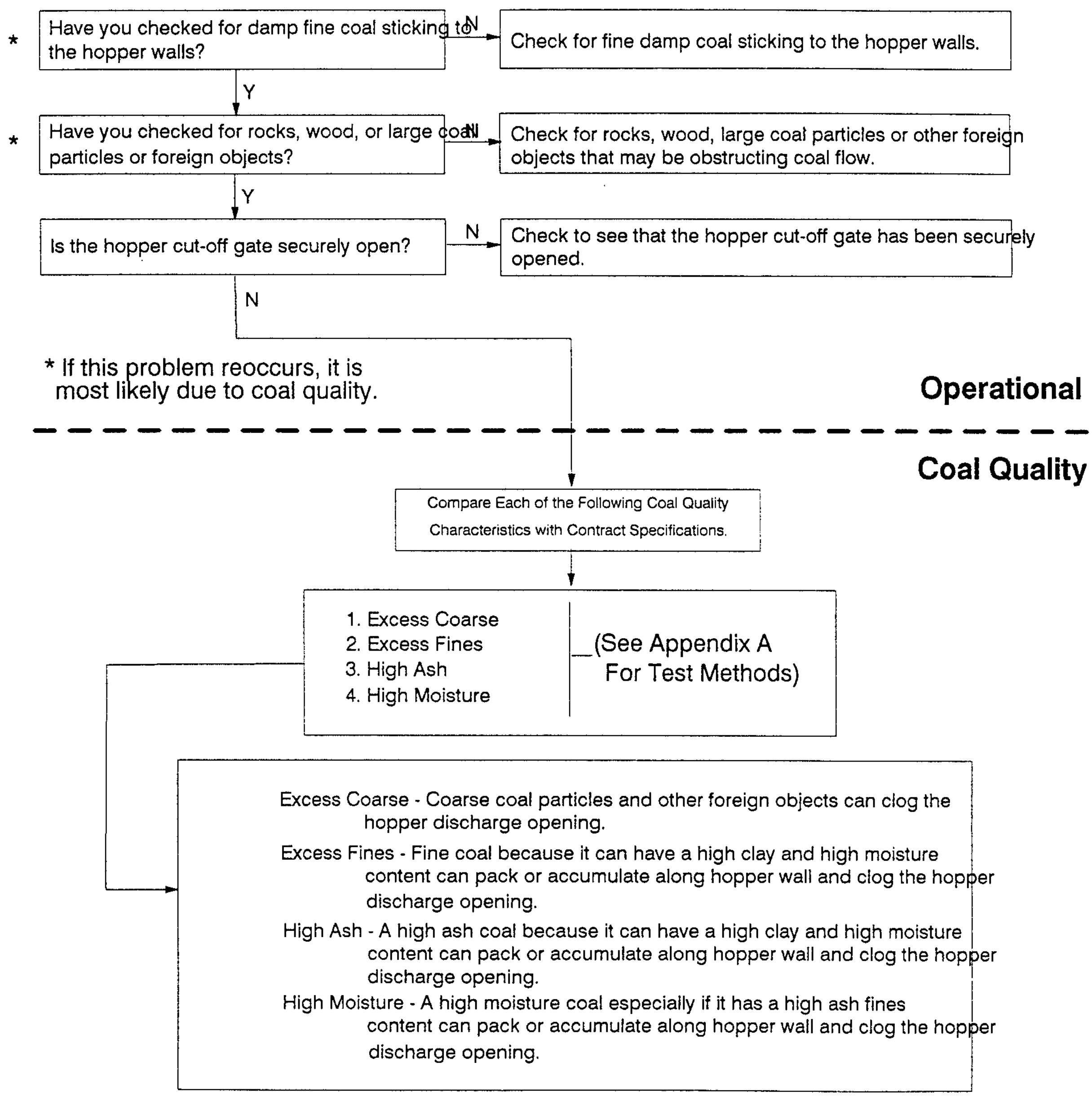


FIG2-50n/2

FIGURE 2-51: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Feeder-Distributor Mechanism

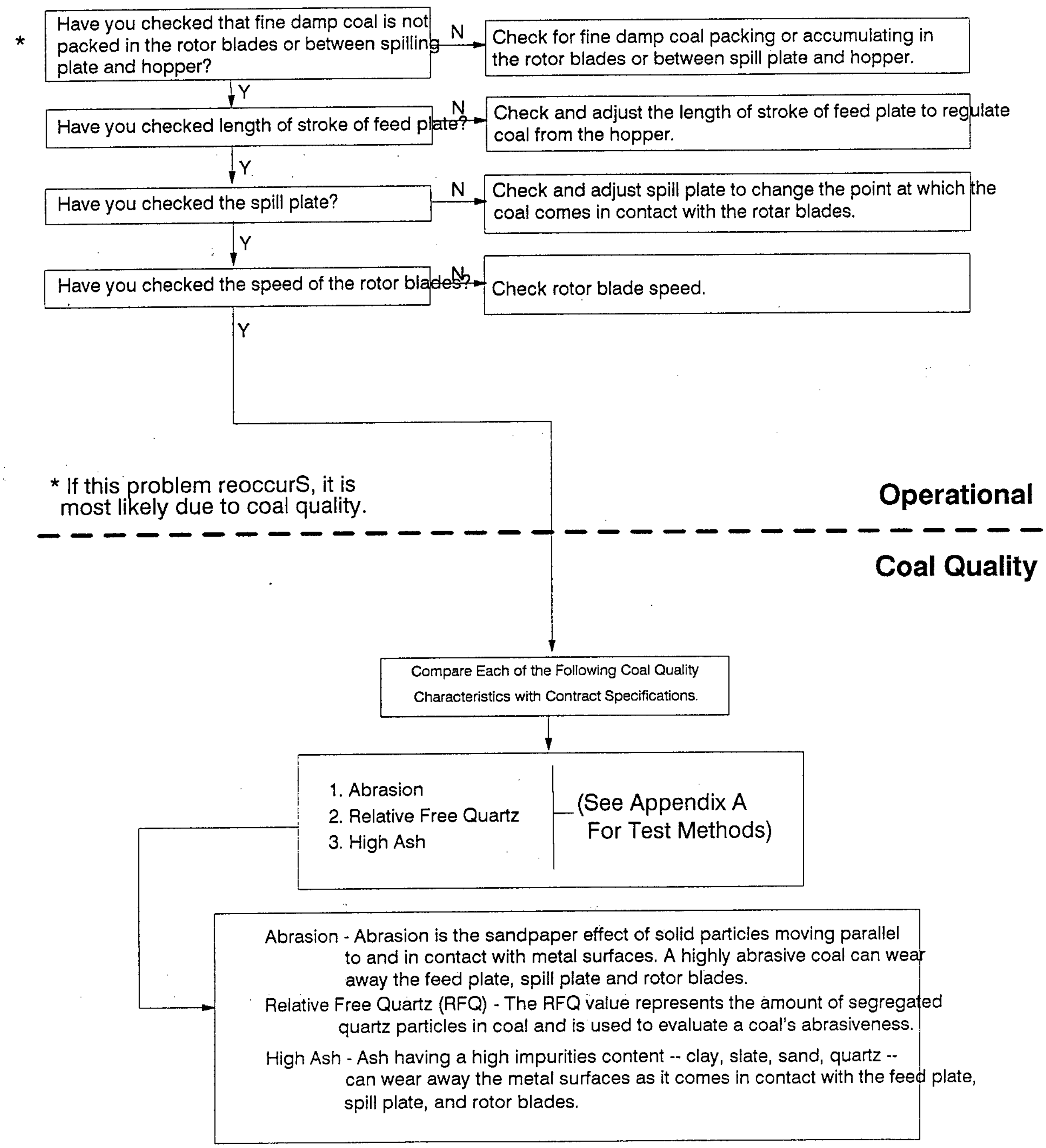


FIG2-51n/2

FIGURE 2-52: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage From The Feeder Distributor Mechanism

* Have you checked for large coal particles, rocks, wood or other foreign objects preventing coal flow from the spill plate to rotor?	N	Check for and remove any large coal particles, rocks, wood or other foreign objects that may be preventing coal flow from spill plate to rotor.
	Y	
* Have you checked for large coal particles or other foreign objects that may be plugging rotor blades?	N	Check for and remove any large coal particles or foreign objects that may be plugging the rotor blades
	Y	
* Have you checked for fine damp coal that has become packed or accumulated between spill plate and hopper discharge or in between rotor blades?	N	Check for and remove fine damp material that may have accumulated or become packed between spill plate and hopper discharge or in between rotor blades.
	Y	
* Have you checked the coal hopper for pluggage?	N	Check the coal hopper for pluggage. NOTE: See Operational Section of Figure 4-48.
	Y	
* Have you checked the coal feeder for pluggage?	N	Check the coal feeder for pluggage. NOTE: See figure 4-6 to identify the type of coal feeder you have and follow the operational section of the corresponding logic diagram for pluggage.
	Y	
* Have you checked the raw coal bunker for pluggage?	N	Check the raw coal bunker for pluggage. NOTE: See operational section of figure 4-45.
	Y	
* Have you checked the coal feed conveyor for pluggage?	N	Check the coal feed conveyor for pluggage. NOTE: See figure 4-6 to identify the type of coal feed conveyor you have and follow the operational section of the corresponding logic diagram for pluggage.
	Y	
* Have you checked your automatic coal reclaim for pluggage?	N	Check your automatic coal reclaim for pluggage. NOTE: See figure 4-6 to identify the type of automatic coal reclaim you have and follow the operational section of the corresponding logic diagram for pluggage.
	Y	

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

See next page for Coal Quality Section

FIG2-52n/3

FIGURE 2-52 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage From The Feeder Distributor Mechanism

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles may become lodged between rotor and rotor blades, and hopper discharge and spill plate preventing coal flow.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed or accumulate between hopper discharge and spill plate or between rotor blade.

High Ash - A high ash coal because it can have a high clay and a high moisture content can become packed or accumulate between hopper discharge and spill plate or between rotor blades.

High Moisture - A wet coal can become packed or accumulate between hopper discharge and spill plate or between rotor blades.

FIG2-52BN/2

FIGURE 2-53: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity From The Feeder Distributor Mechanism

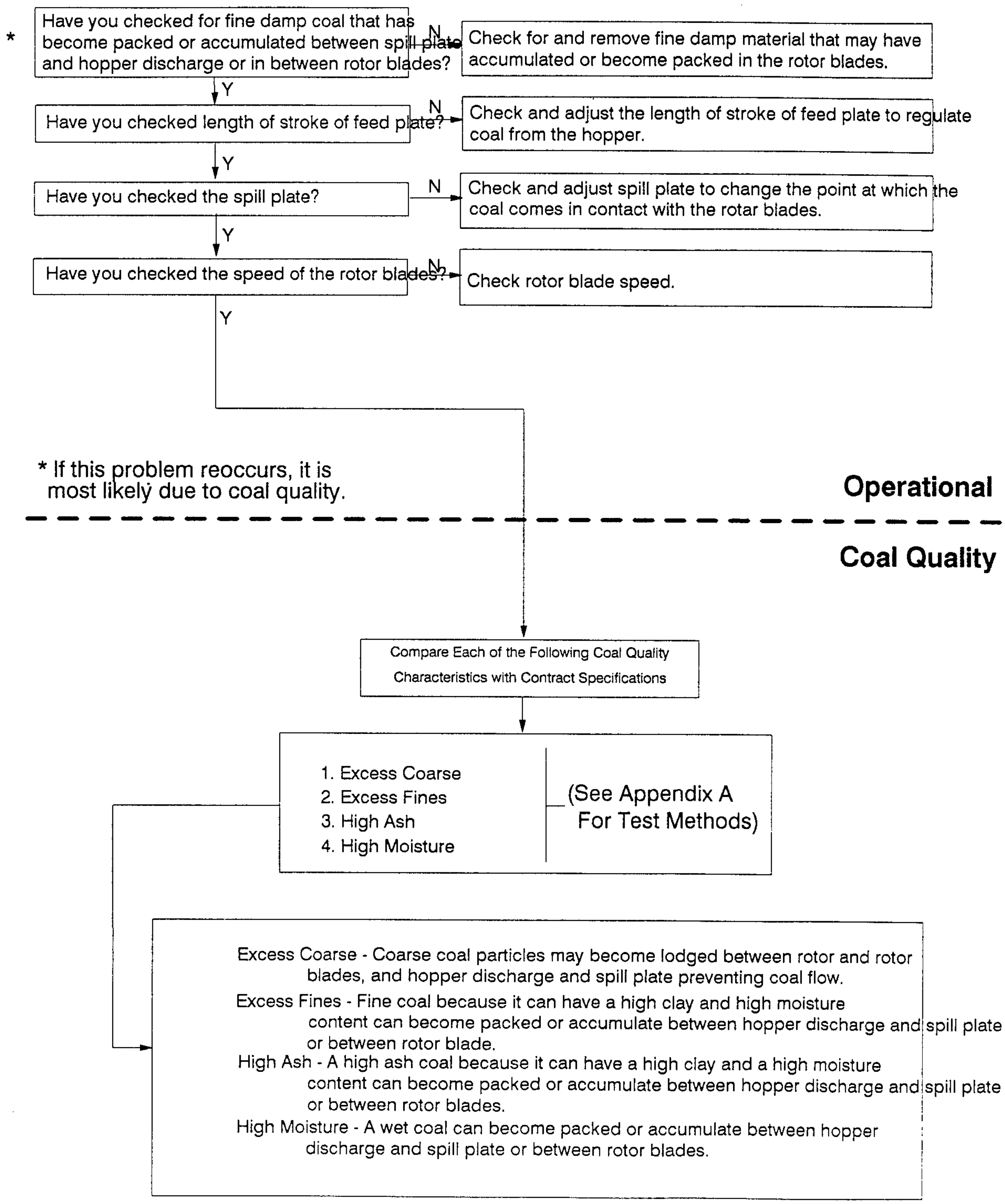


FIG2-53n/2

FIGURE 2-54: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Feeder Distributor Mechanism

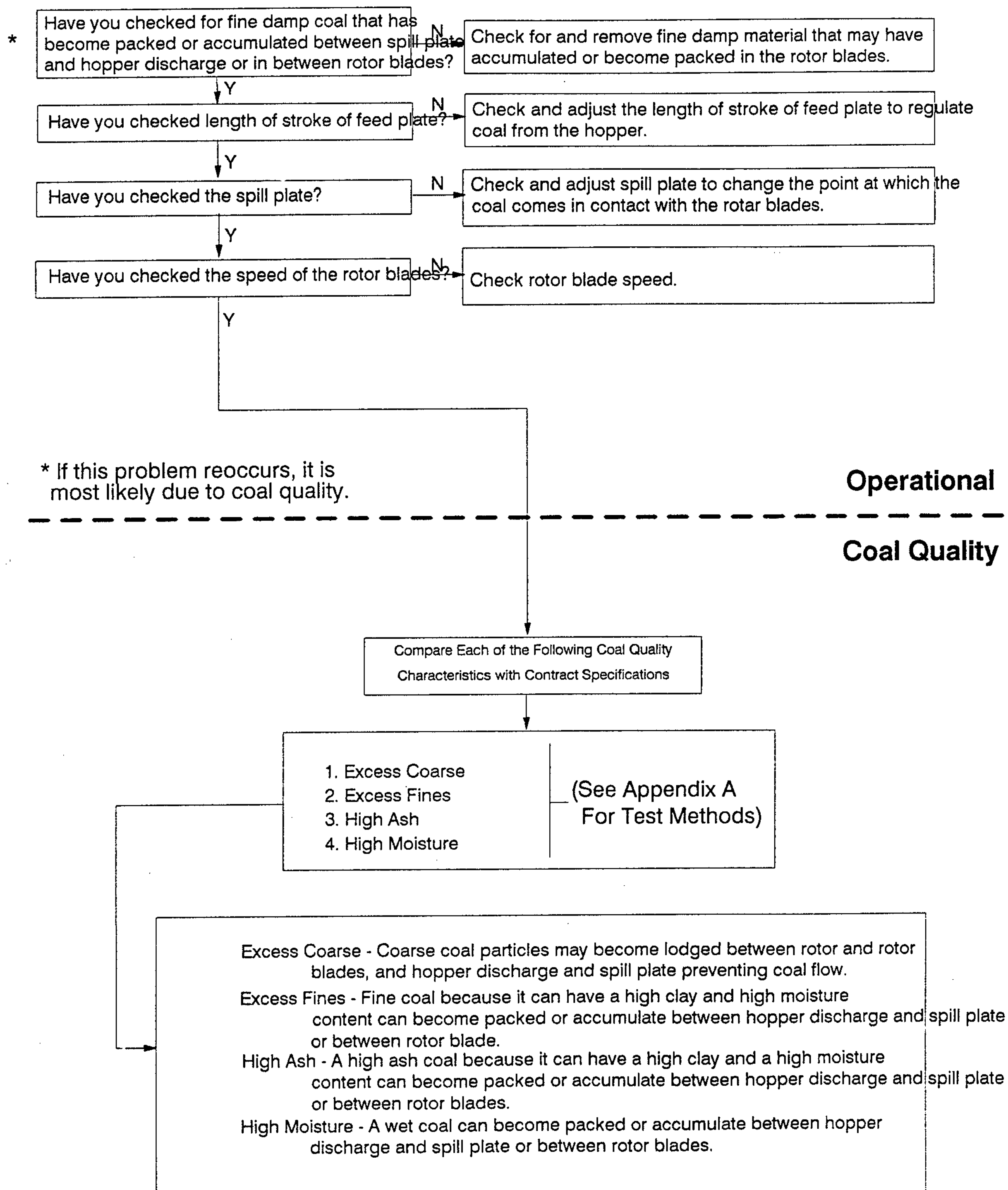
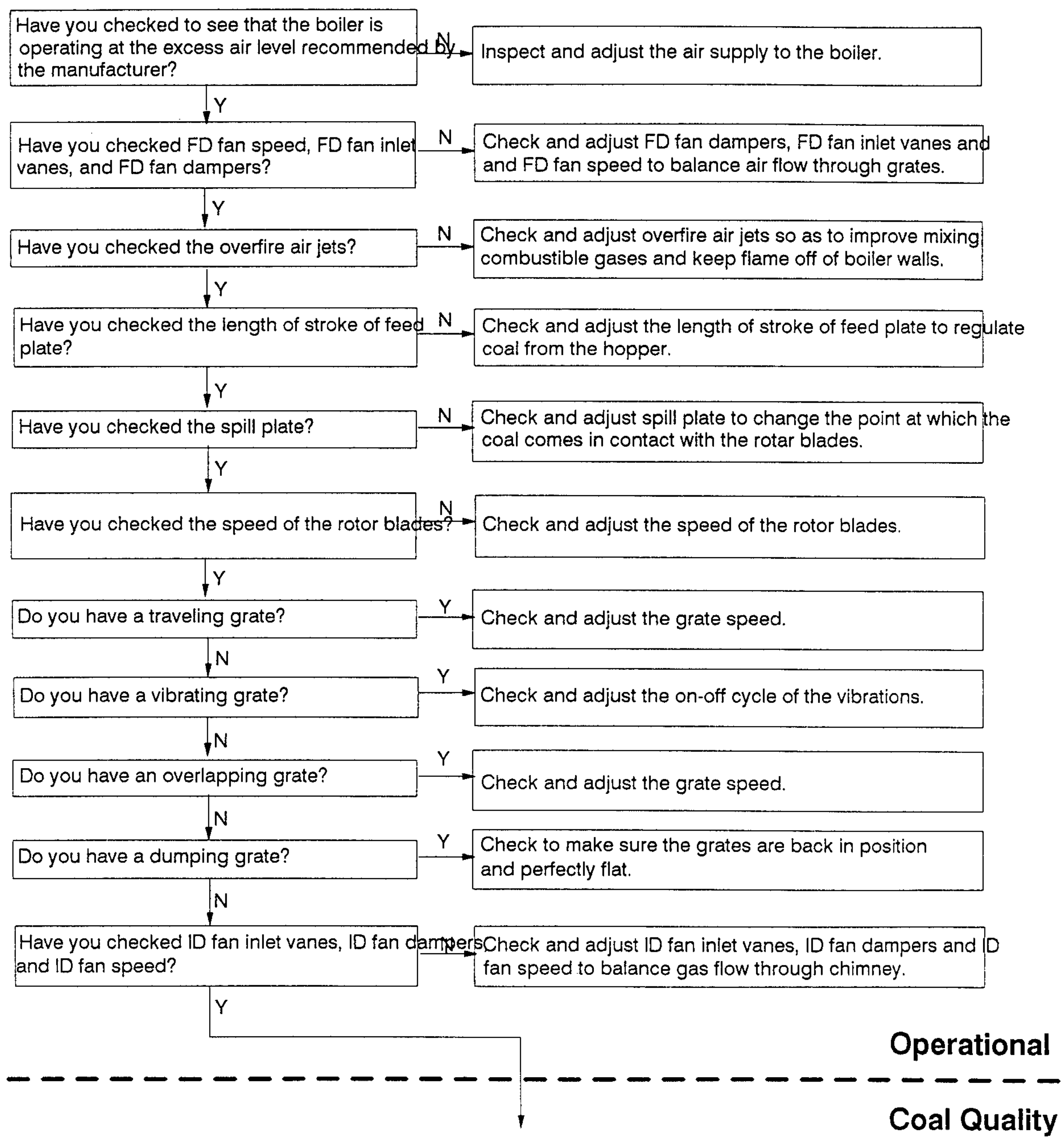


FIG2-54n/2

FIGURE 2-55: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Boiler)



See next page for Coal Quality Section.

FIG2-55n/2

FIGURE 2-55 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Insufficient Capacity And Inability To Meet Load

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. High ASH
5. Excess Coarse
6. Excess Fine
7. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

High Ash - If excessive ash particles can become sufficiently thick on the grate to seriously restrict air flow through the grate and fuel bed making it difficult to complete combustion.

Excess Coarse - Coarse coal tends to segregate in coal conveying equipment and hoppers causing uneven burning, an uneven ash and coal bed on the grate.

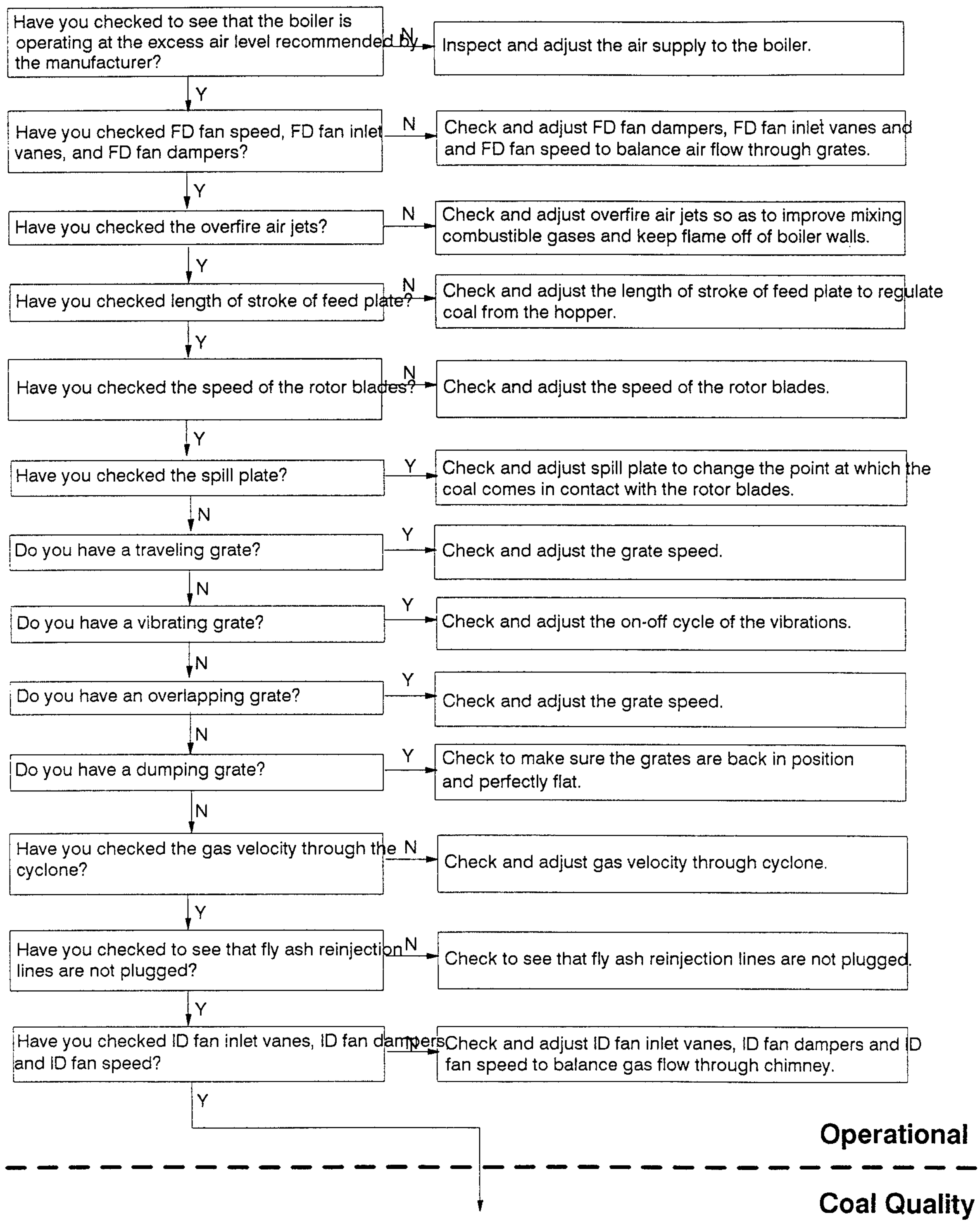
Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG2-55nb/2

FIGURE 2-56: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Reduced Boiler Efficiency



See next page for Coal Quality Section.

FIG2-56n/2

FIGURE 2-56 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Reduced Boiler Efficiency

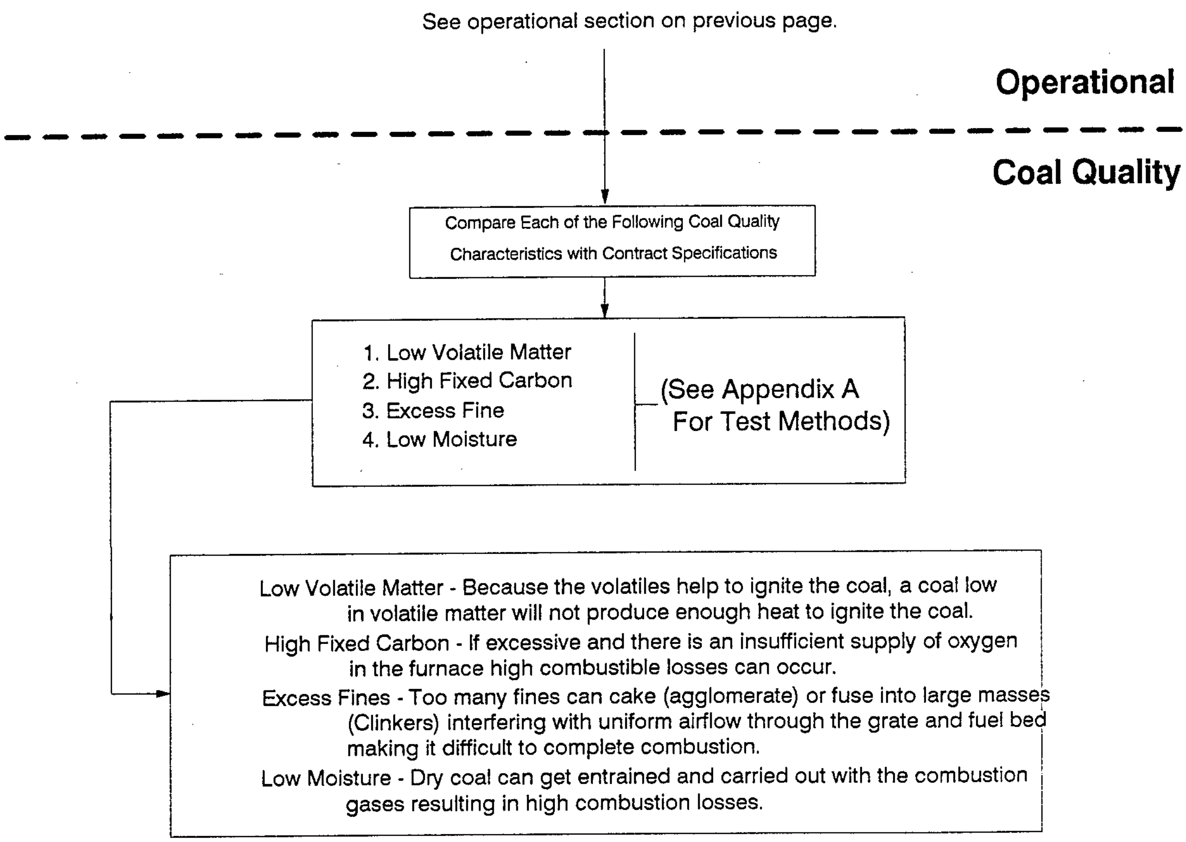


FIG2-56nb/2

FIGURE 2-57: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Boiler Components
(Grates)

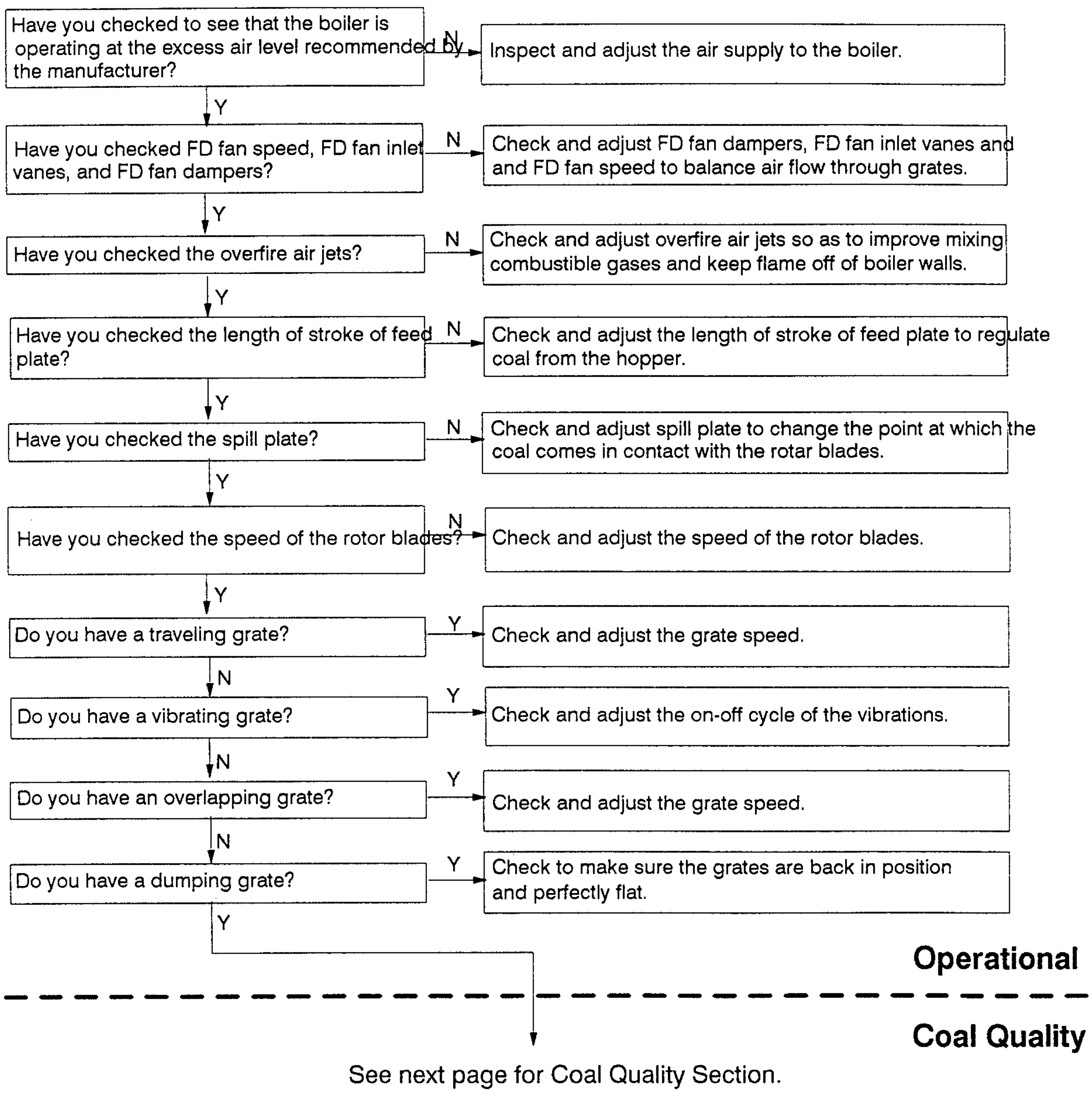


FIG2-57n/2

FIGURE 2-57 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Boiler Components
(Grates)

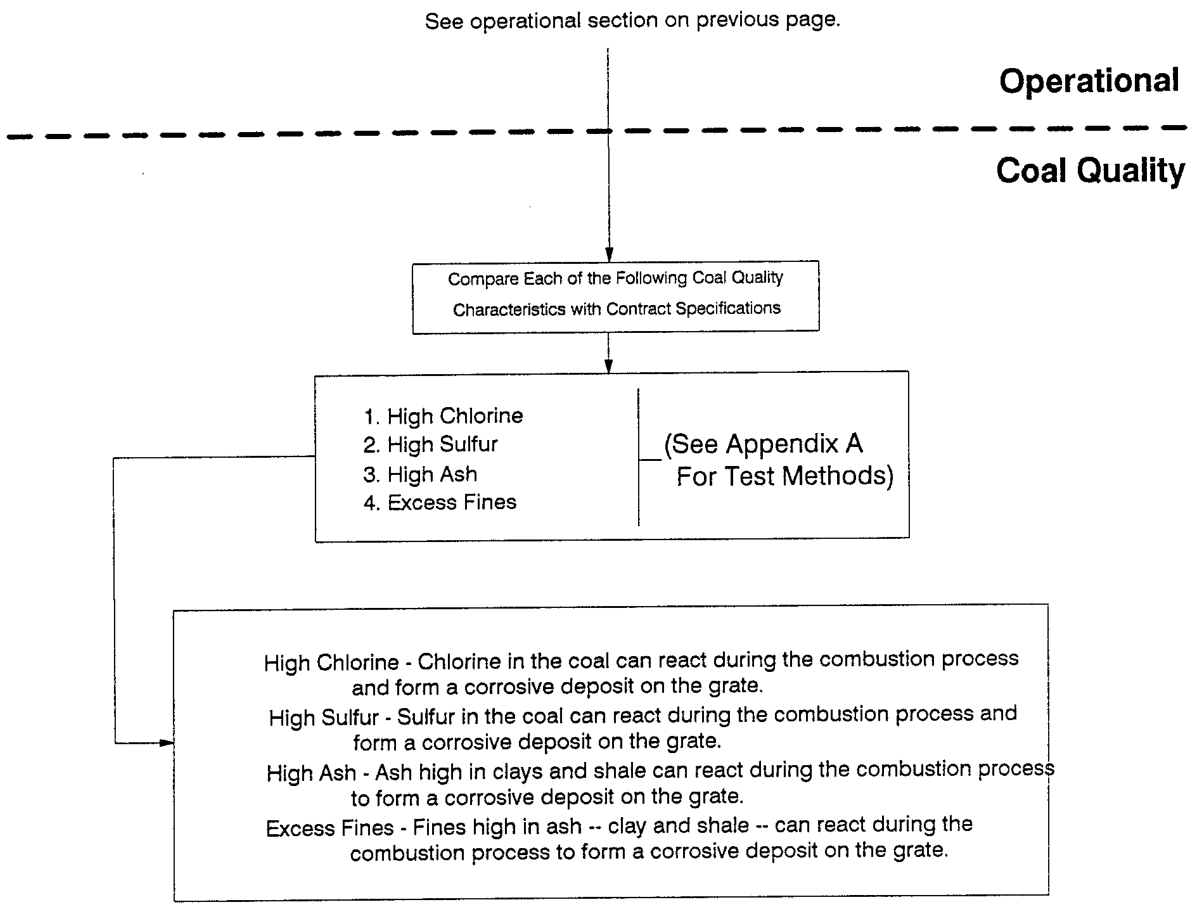


FIG2-57nb/2

FIGURE 2-58: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Segregation On The Grate

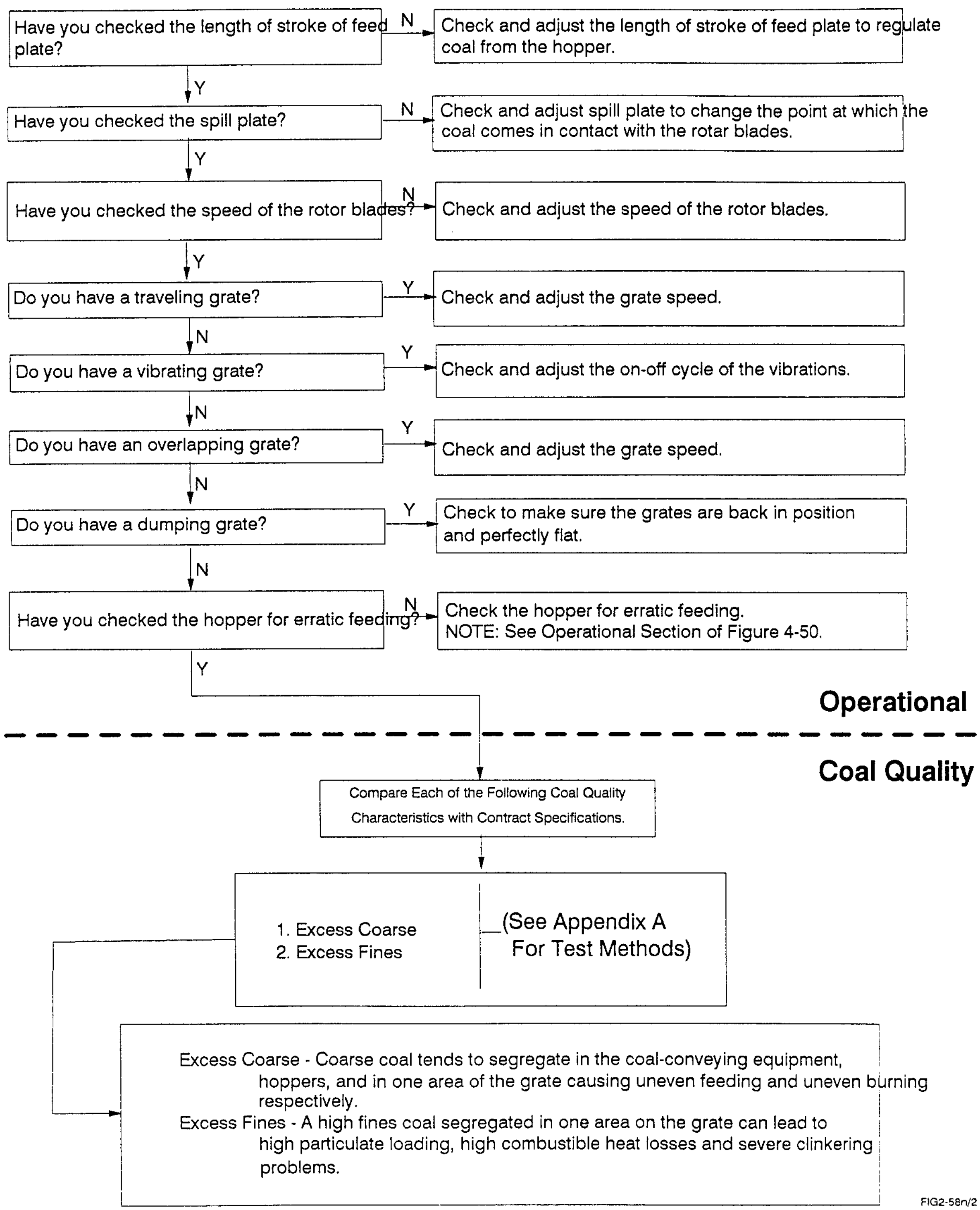
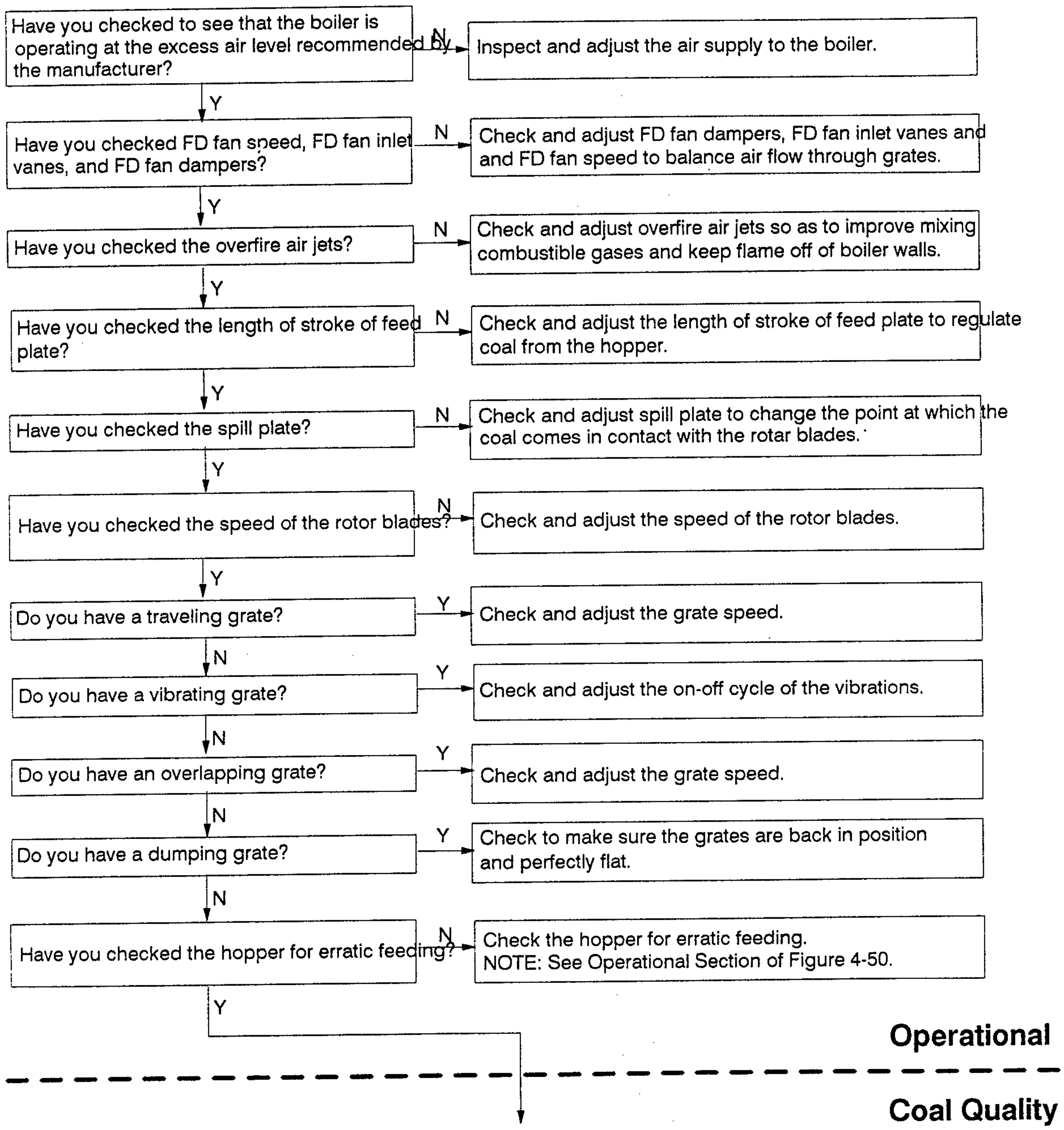


FIGURE 2-59: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pressure Across The Grates



See next page for Coal Quality Section.

FIG2-59n/2

FIGURE 2-59 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pressure Across The Grates

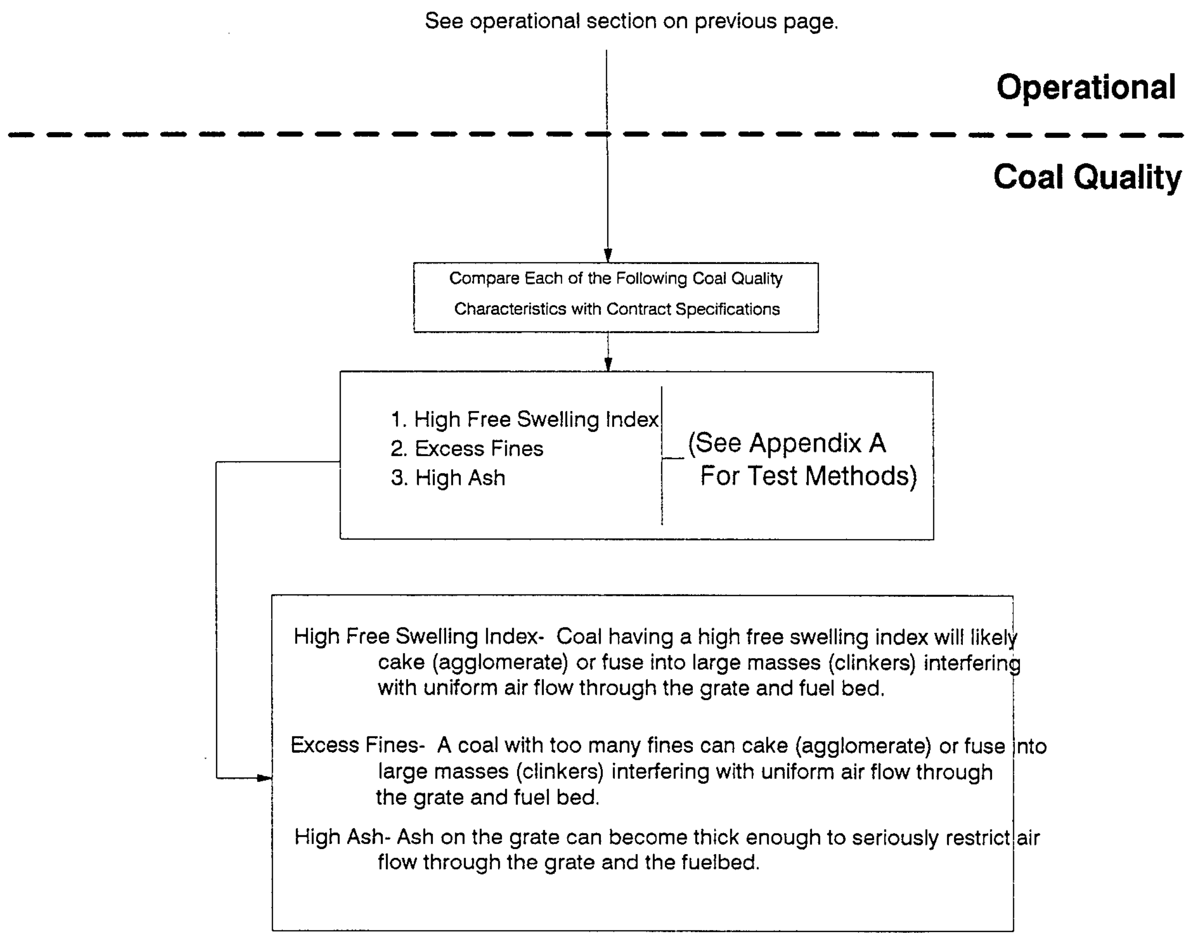
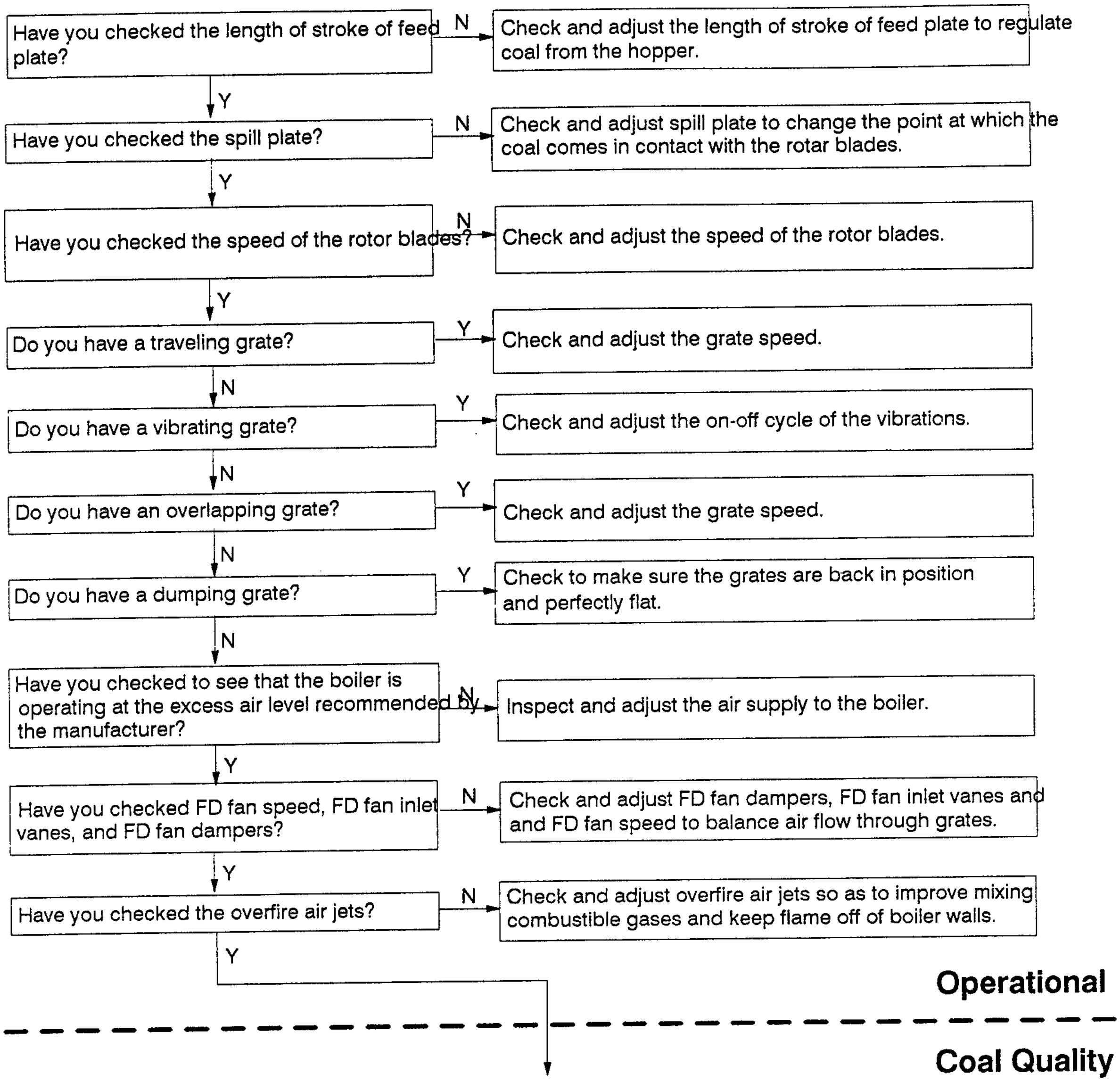


FIG2-59nb/2

FIGURE 2-60: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Ash Bed On Grate



See next page for Coal Quality Section.

FIG2-60n/2

FIGURE 2-60 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Ash Bed On Grate

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. High Moisture
4. High Free Swelling Index

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal tends to segregate in the coal conveying equipment and in the hopper causing uneven feeding, uneven burning and an uneven ash coal bed.

Excess Fines - A high fines coal can segregate in one area of the grate causing uneven burning.

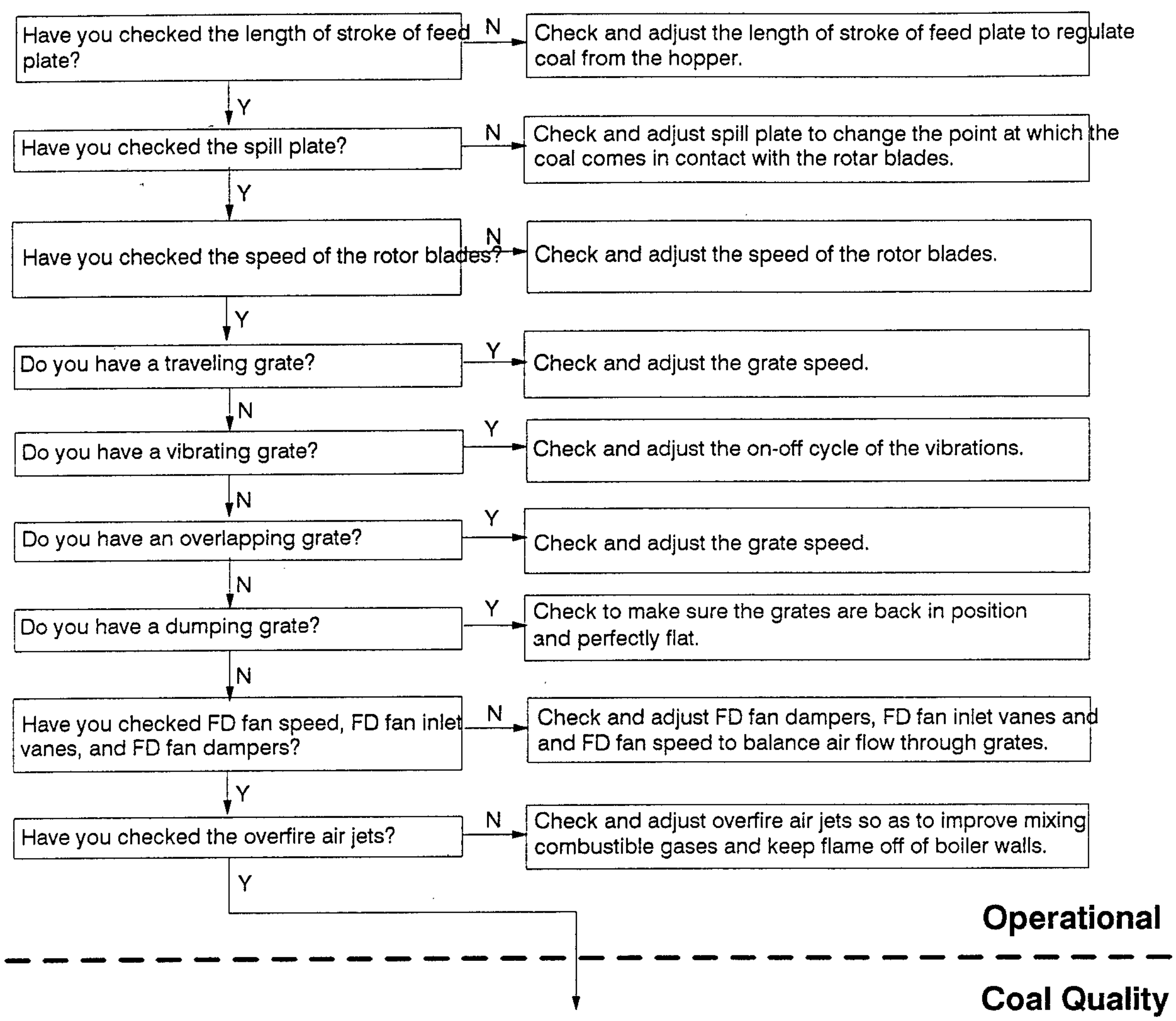
High Moisture - Wet coal may clog in chutes or hopper causing uneven or erratic feeding, uneven burning and an uneven ash or coal bed.

High Free Swelling Index(FSI) - Coking coals -- the FSI is an indication of the coking tendencies of coal -- tend to swell and produce a deep fuel bed.

FIG2-60nb/2

FIGURE 2-61: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Coal Bed On The Grate



See next page for Coal Quality Section.

FIG2-61n/2

FIGURE 2-61 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Coal Bed On The Grate

See operational section on previous page.

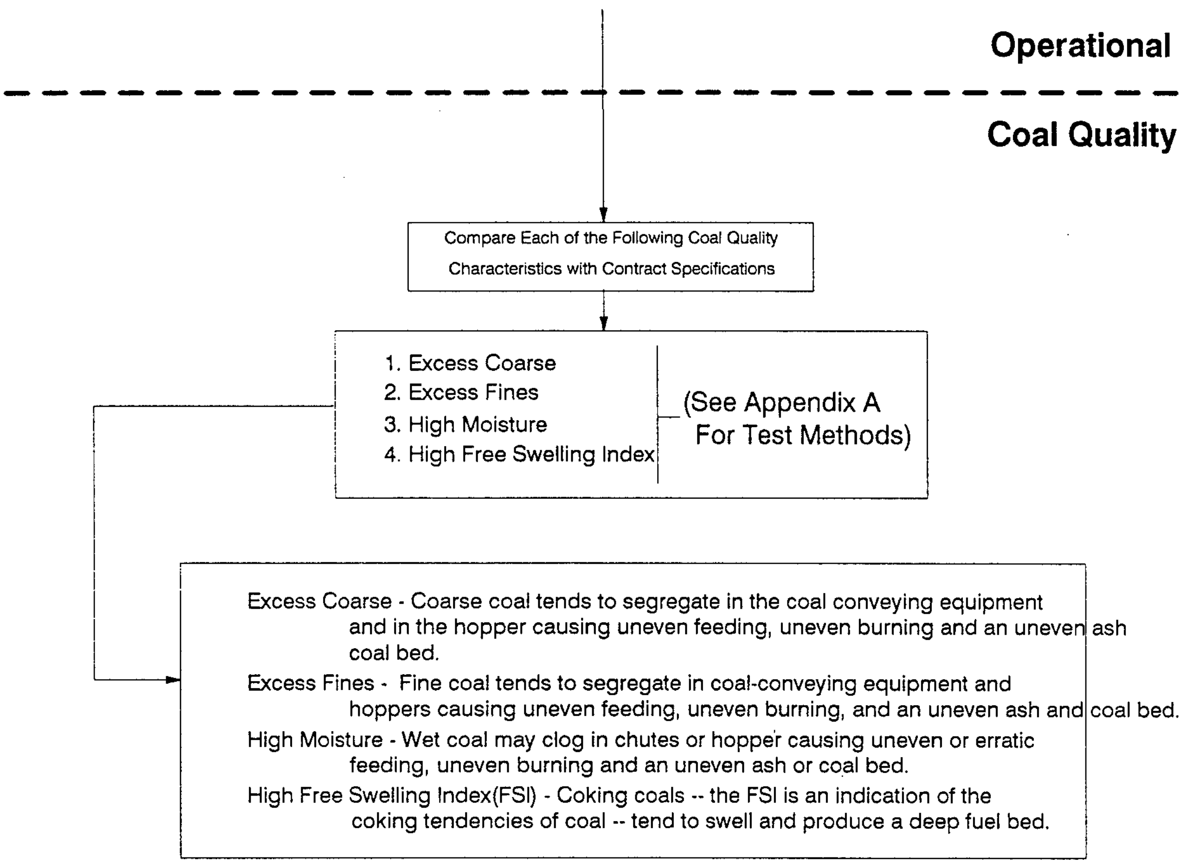
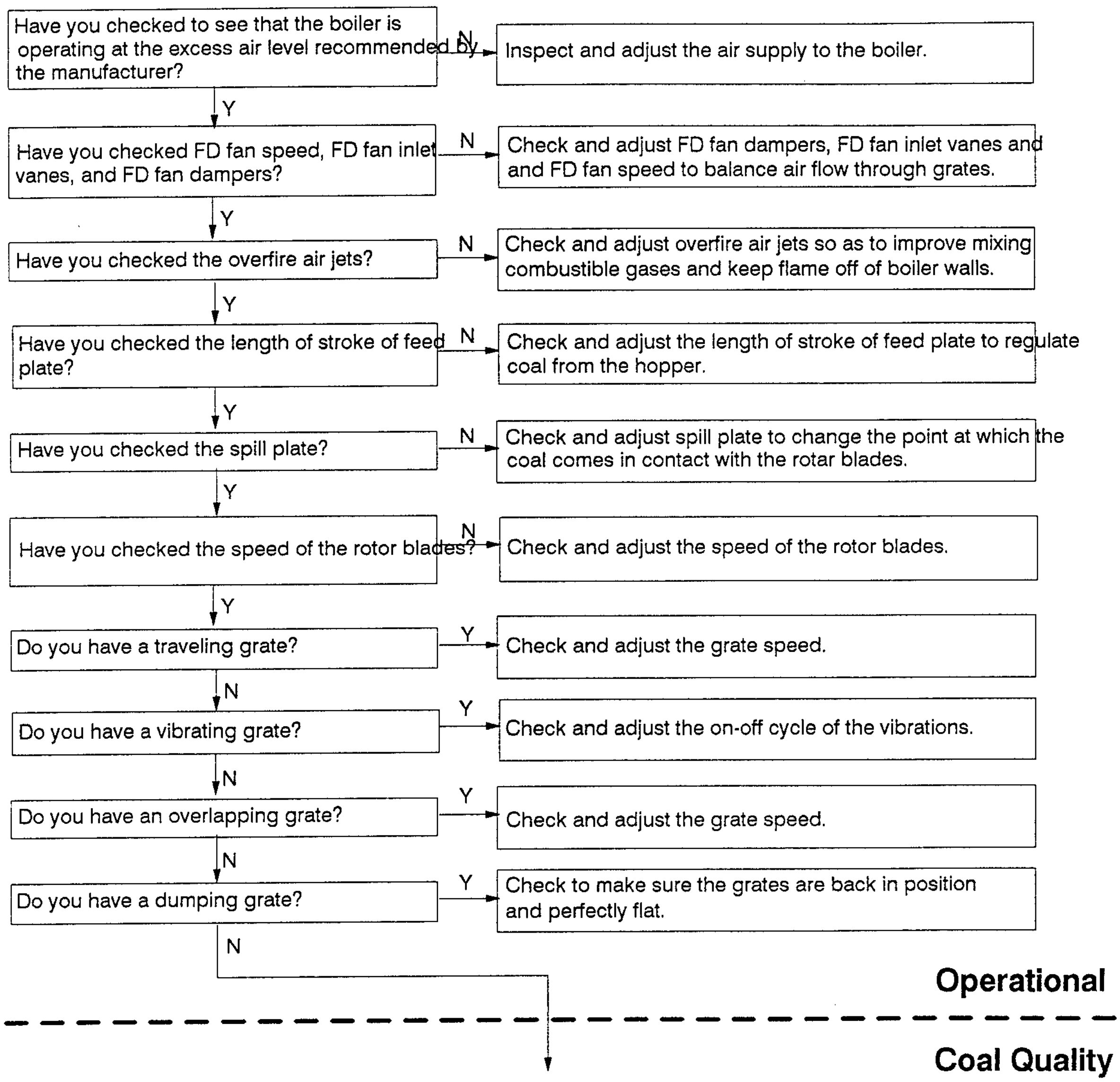


FIG2-61nb/2

FIGURE 2-62: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Burning On the Grate



See next page for Coal Quality Section.

FIG2-62n/2

FIGURE 2-62 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Burning On The Grate

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. High Moisture
4. High Free Swelling Index

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal tends to segregate in the coal conveying equipment and in the hopper causing uneven feeding, uneven burning and an uneven ash coal bed.

Excess Fines - Fine coal tends to segregate in coal-conveying equipment and hoppers causing uneven feeding, uneven burning, and an uneven ash and coal bed.

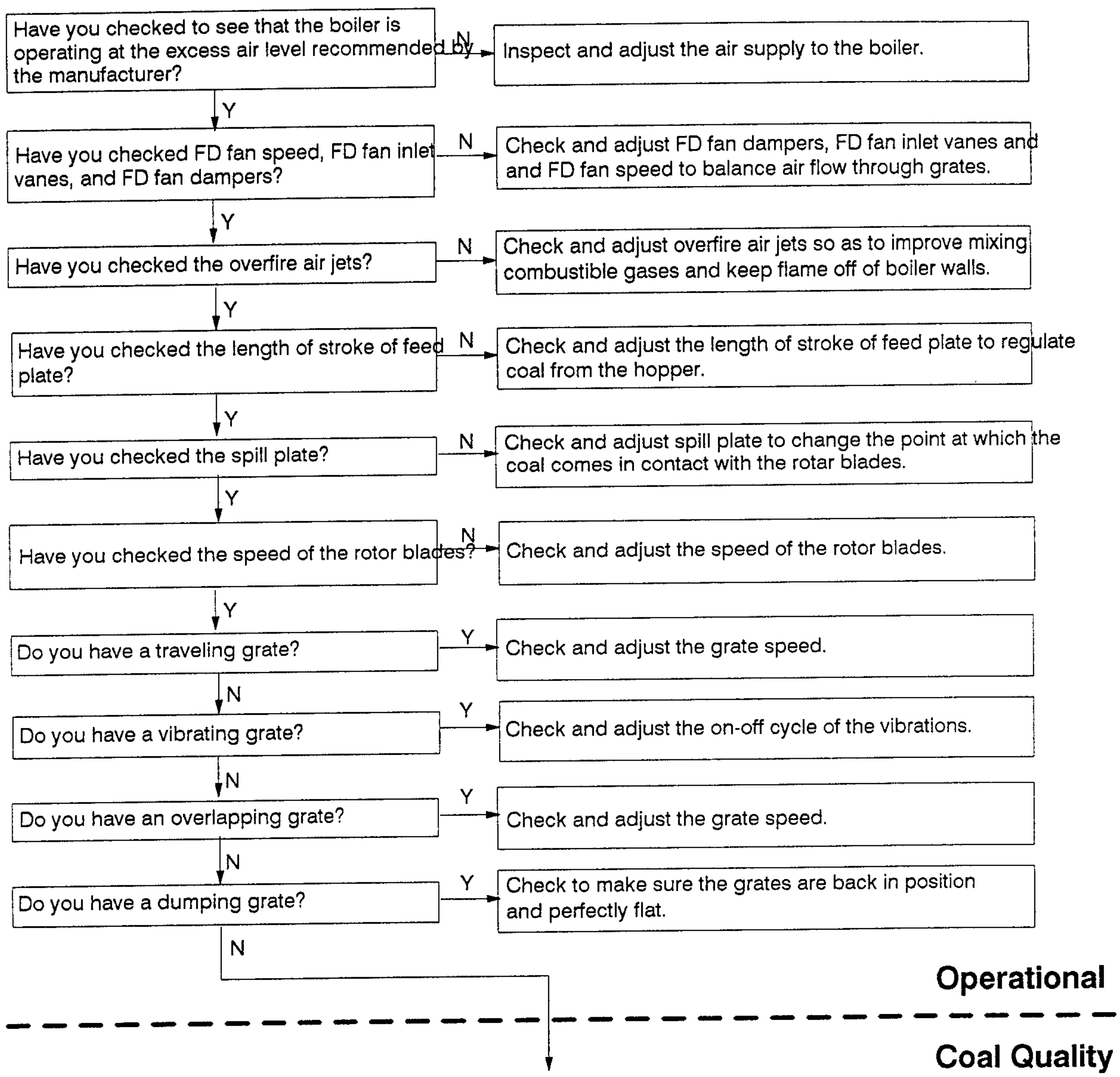
High Moisture - Wet coal may clog in chutes or hopper causing uneven or erratic feeding, uneven burning and an uneven ash or coal bed.

High Free Swelling Index(FSI) - Coking coals -- the FSI is an indication of the coking tendencies of coal -- tend to swell and produce a deep fuel bed.

FIG2-62nb/2

FIGURE 2-63: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Warped, Burnt, Cracked Grates



See next page for Coal Quality Section.

FIG2-63n/2

FIGURE 2-63 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Warped, Burnt, Cracked Grates

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. Low Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal can segregate in one area of the grate creating a thin coal or ash bed on another area of the bed exposing the grates and tuyeres to the furnace heat.

Excess Fines - Fine coal can segregate in one area of the grate creating a thin coal or ash bed exposing the grates and tuyeres to the furnace heat.

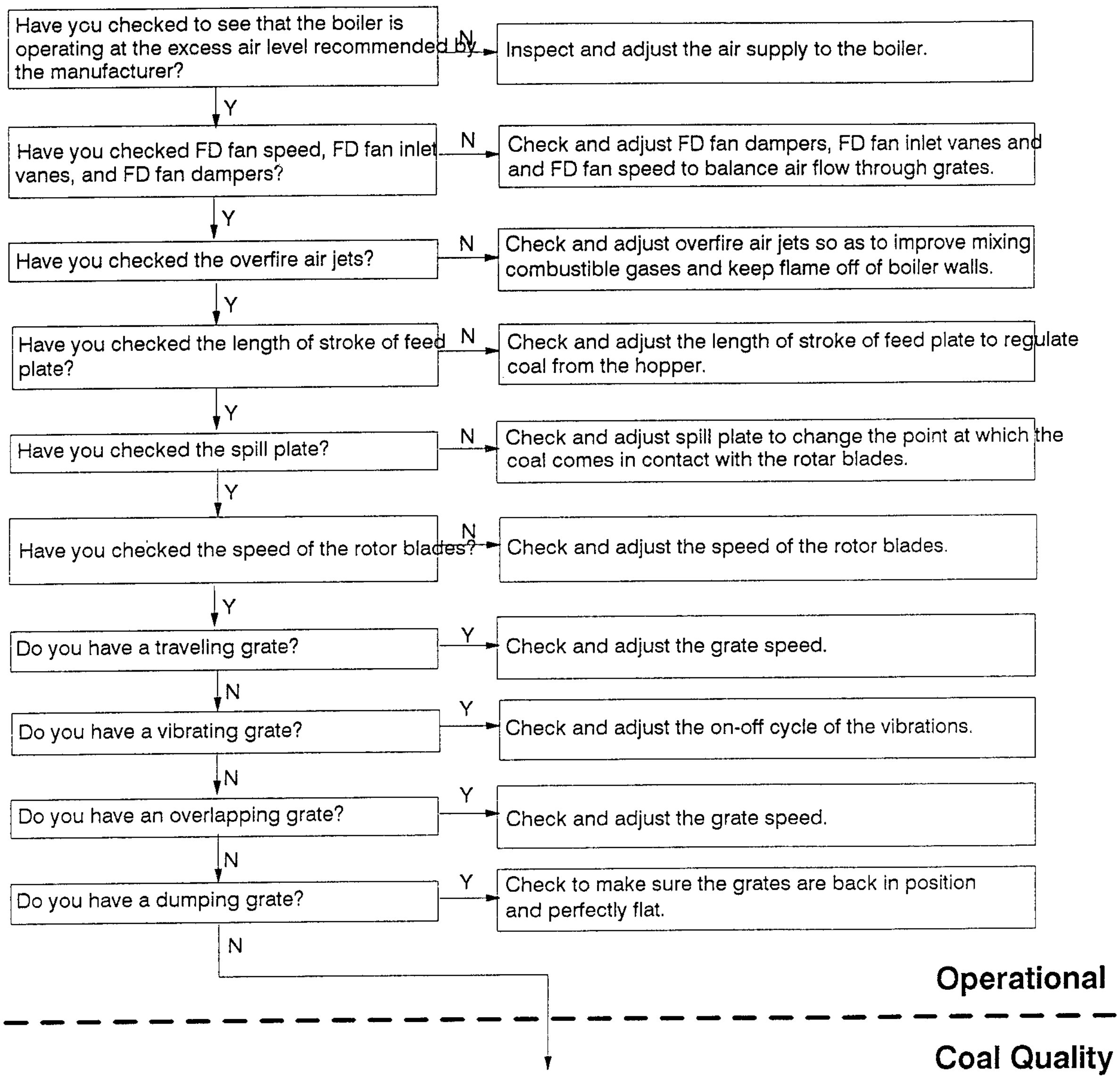
Low Ash - The grates and tuyeres depend upon a covering of ash to protect them from the furnace heat, and a low-ash coal may not provide adequate protection

High Moisture - Wet coal can clog in the supply chute or coal hopper while the stoker is in operation causing the grates and tuyeres to become exposed to the furnace heat.

FIG2-63nb/2

FIGURE 2-64: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers Of The Grate



See next page for Coal Quality Section.

FIG2-64n/2

FIGURE 2-64 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Clinkers Of The Grate

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Free Swelling
2. Low Ash Fusion Temperature
3. Excess Fines

(See Appendix A For Test Methods)

High Free Swelling Index- Coal having a high free swelling index will likely cake (agglomerate) or fuse into large masses (clinkers) interfering with uniform air flow through the grate and fuel bed.

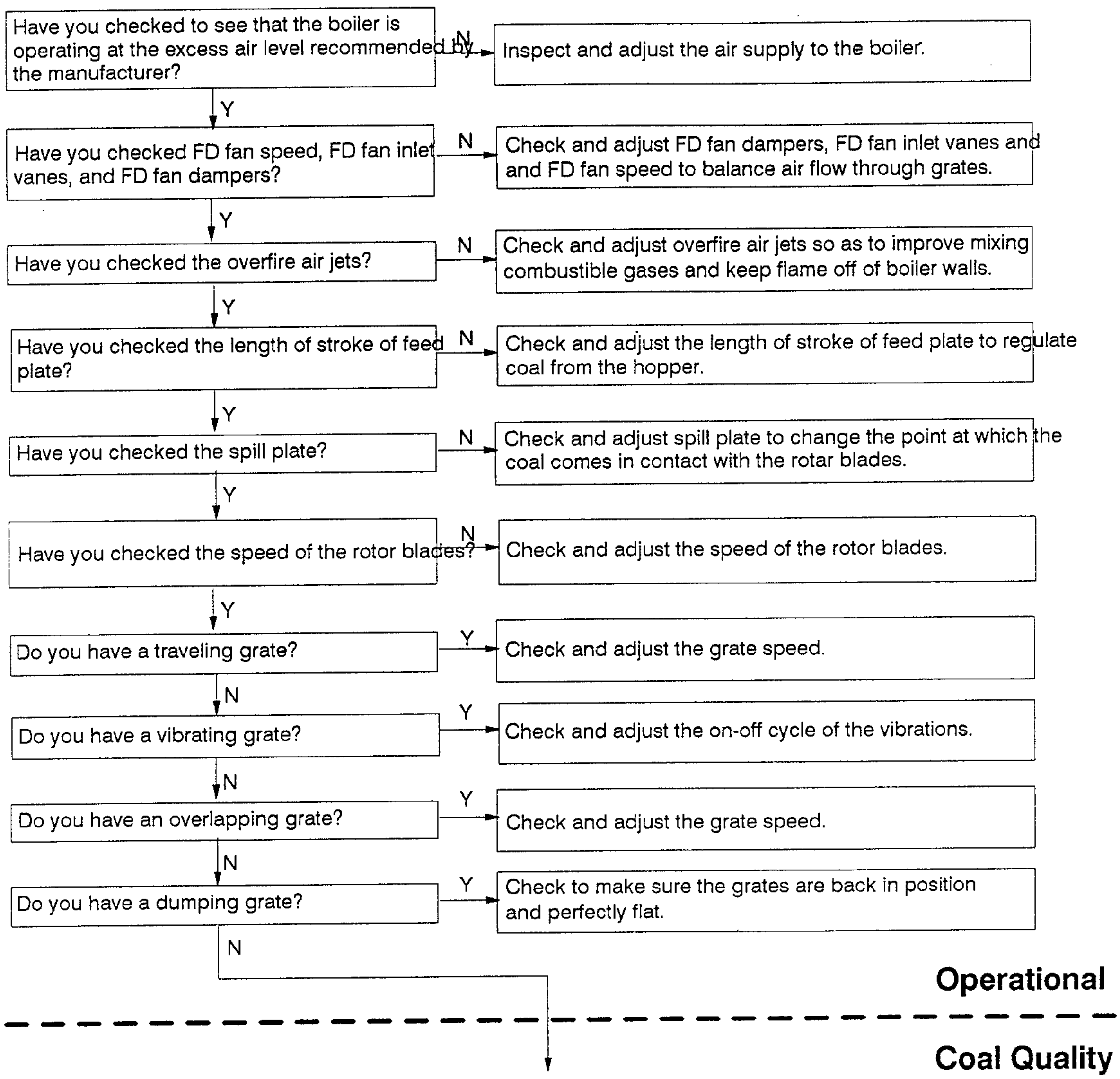
Low Ash Fusion Temperature- Coal with a low ash fusion temperature will become plastic or liquid forming a fused mass (clinker) on the grate surface. Clinkers can shut off air openings in tuyeres and interfere with the movement of fuel on the grate.

Excess Fines- Coal with too many fines can cake (agglomerate) or fuse into large masses (clinkers) interferring with uniform air flow through the grate and fuel bed.

FIG2-64nb/2

FIGURE 2-65: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout On The Grate



See next page for Coal Quality Section.

FIG2-65n/2

FIGURE 2-65 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout On The Grate

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen to react with the carbon in the furnace high combustible losses can occur. Unburnt carbon will be carried over the grate into the ashpit.

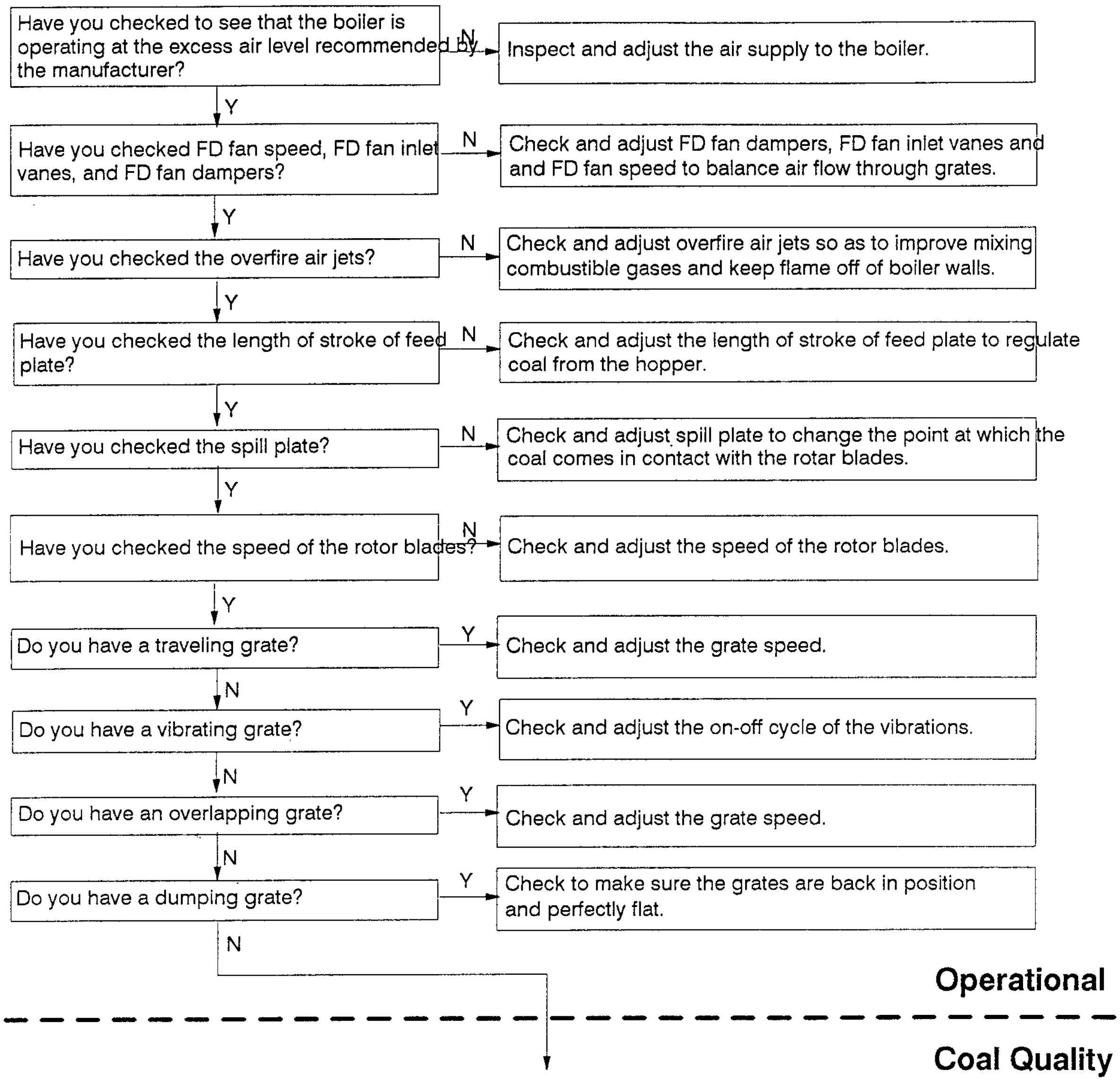
Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal. Unburnt carbon will be carried over the grate into the ashpit.

Excess Fines - Too many fines on the grate can lead to high particulate loadings because they are easily carried out of the furnace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal. Unburnt carbon can then get carried over the grate into the ash pit if there is not enough time allowed for the coal to burn on the grate.

FIG2-65nb/2

FIGURE 2-66: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Refractory Surfaces



See next page for Coal Quality Section.

FIG2-66n/2

FIGURE 2-66 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Refractory Surfaces

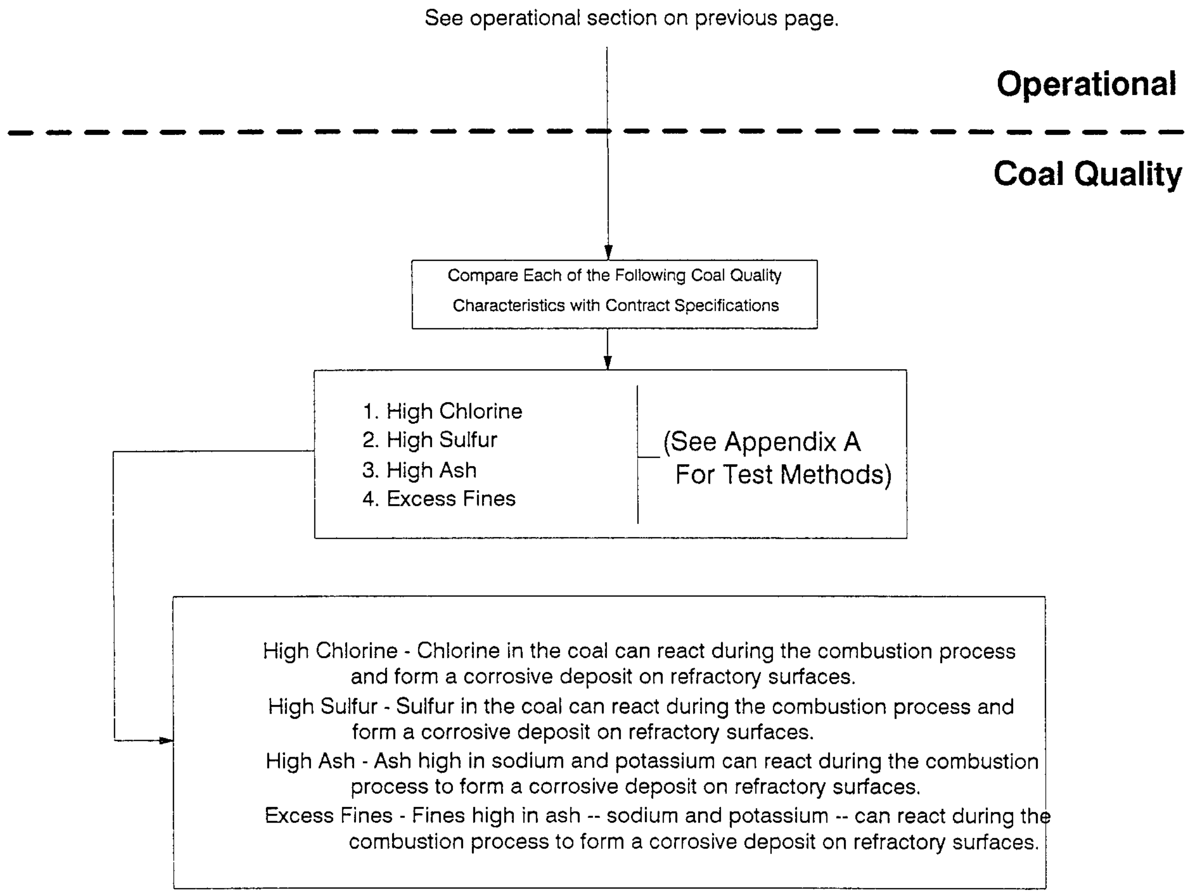
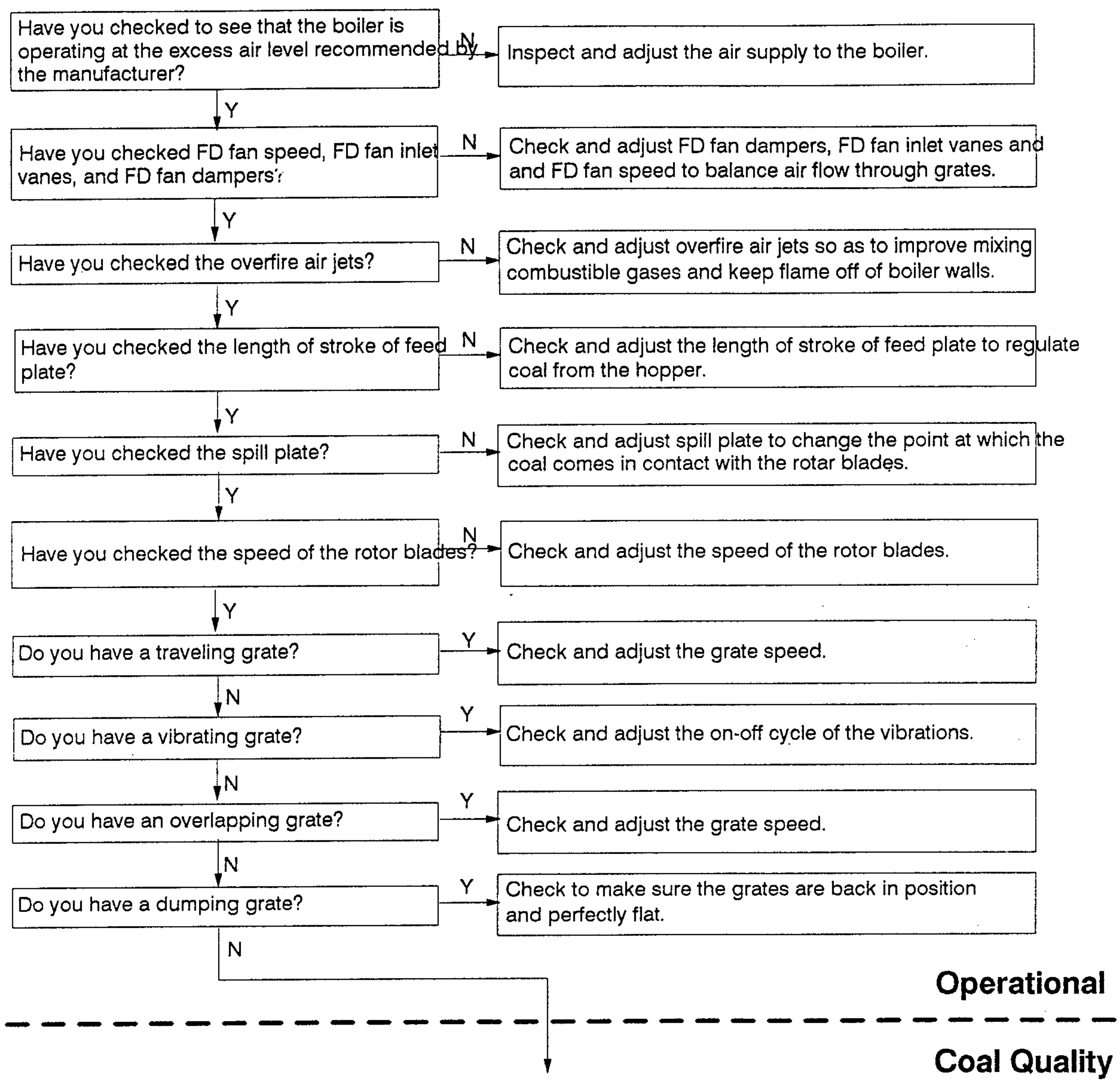


FIG2-66nb/2

FIGURE 2-67: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Refractory Surfaces



See next page for Coal Quality Section.

FIG2-67n/2

FIGURE 2-67 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Refractory Surfaces

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on refractory surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away the surface.

FIG2-67nb/2

FIGURE 2-68: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging/Spalling Of The Boiler Components (Refractory Surfaces)

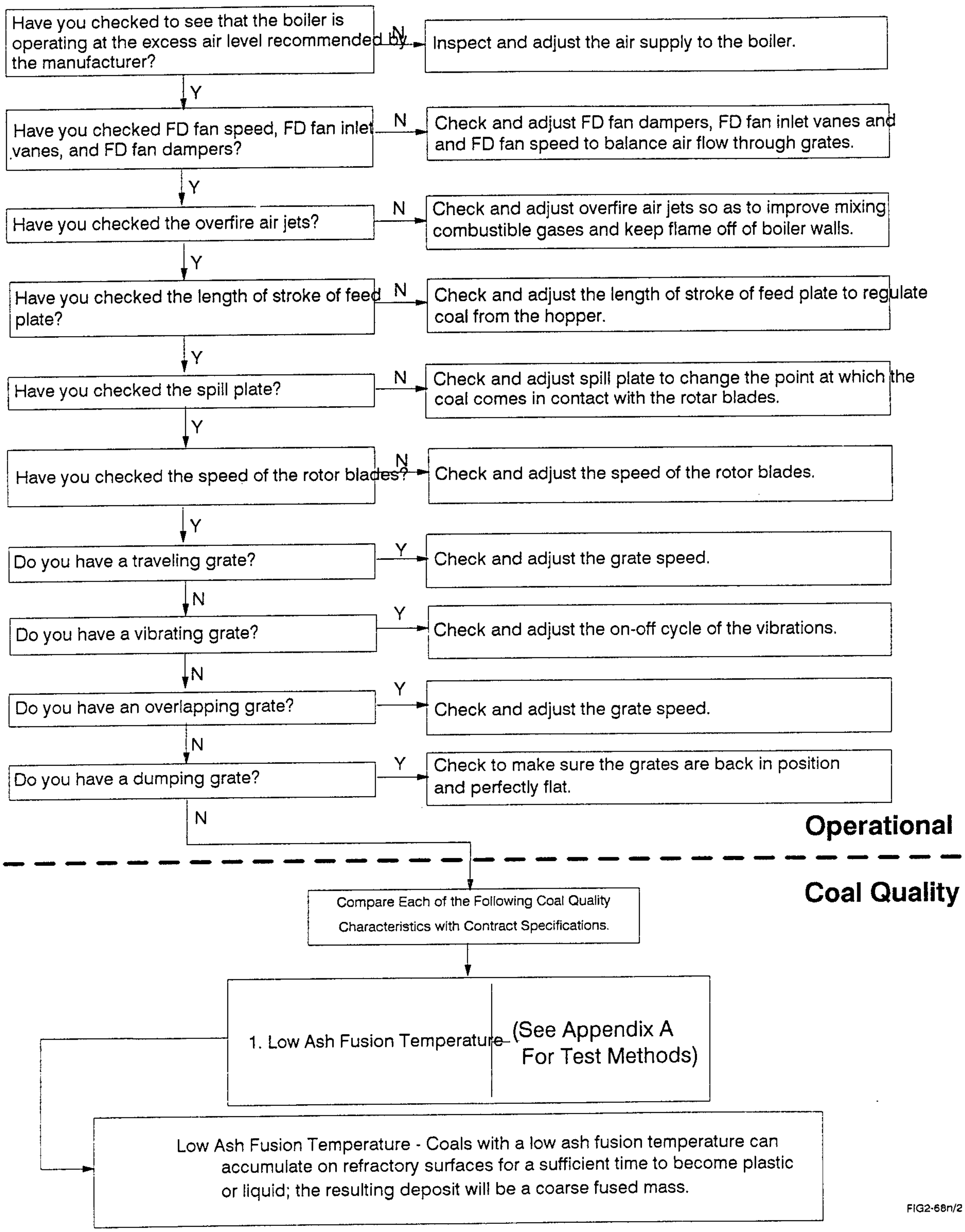
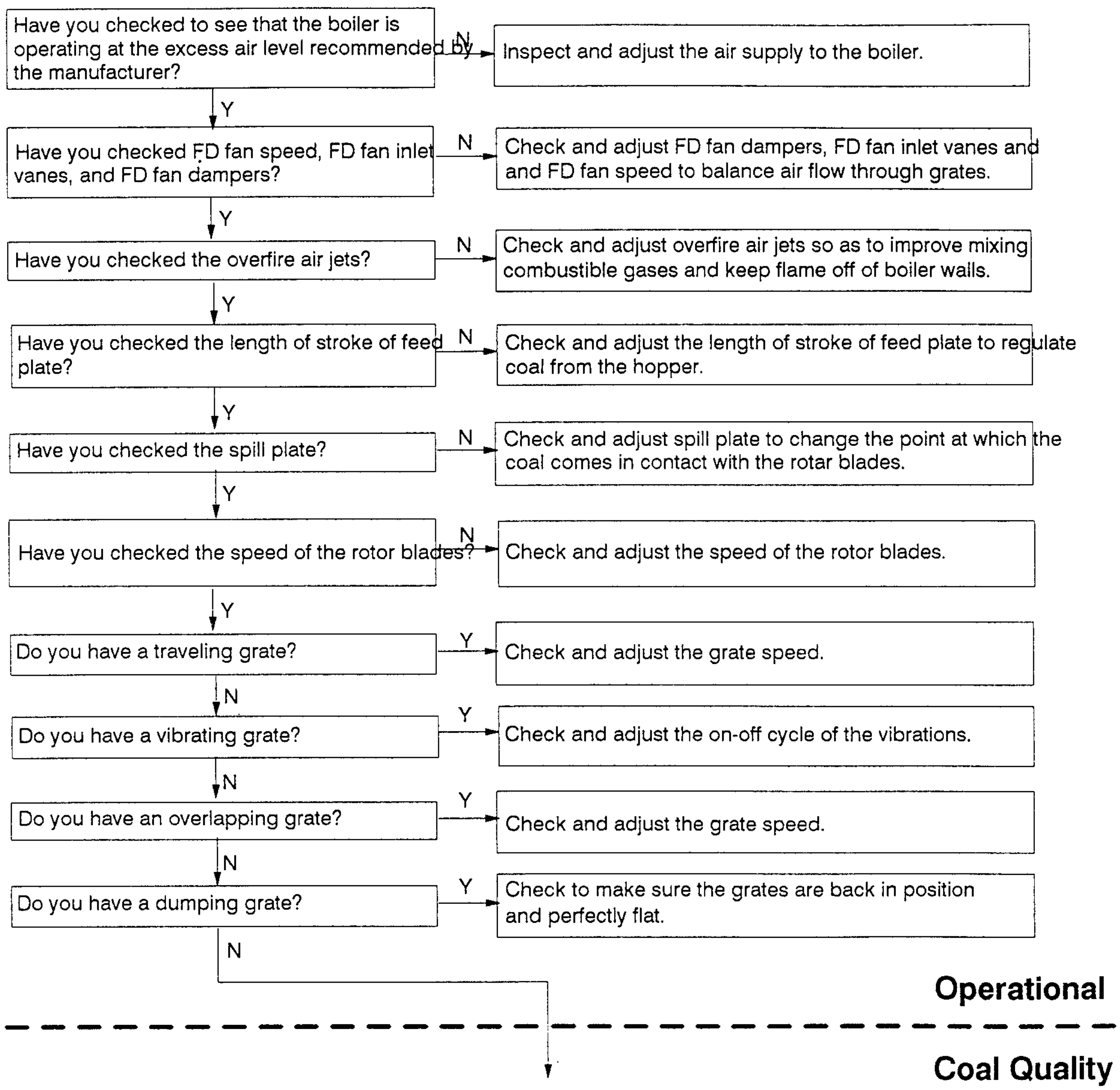


FIG2-68n/2

FIGURE 2-69: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Heat Transfer Surfaces (Boiler Tubes and Water Walls)



See next page for Coal Quality Section.

FIG2-69n/2

FIGURE 2-69 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Chlorine
2. High Sulfur
3. High Ash
4. Excess Fines

(See Appendix A For Test Methods)

High Chlorine - Chlorine in the coal can react during the combustion process and form a corrosive deposit on heat transfer surfaces.

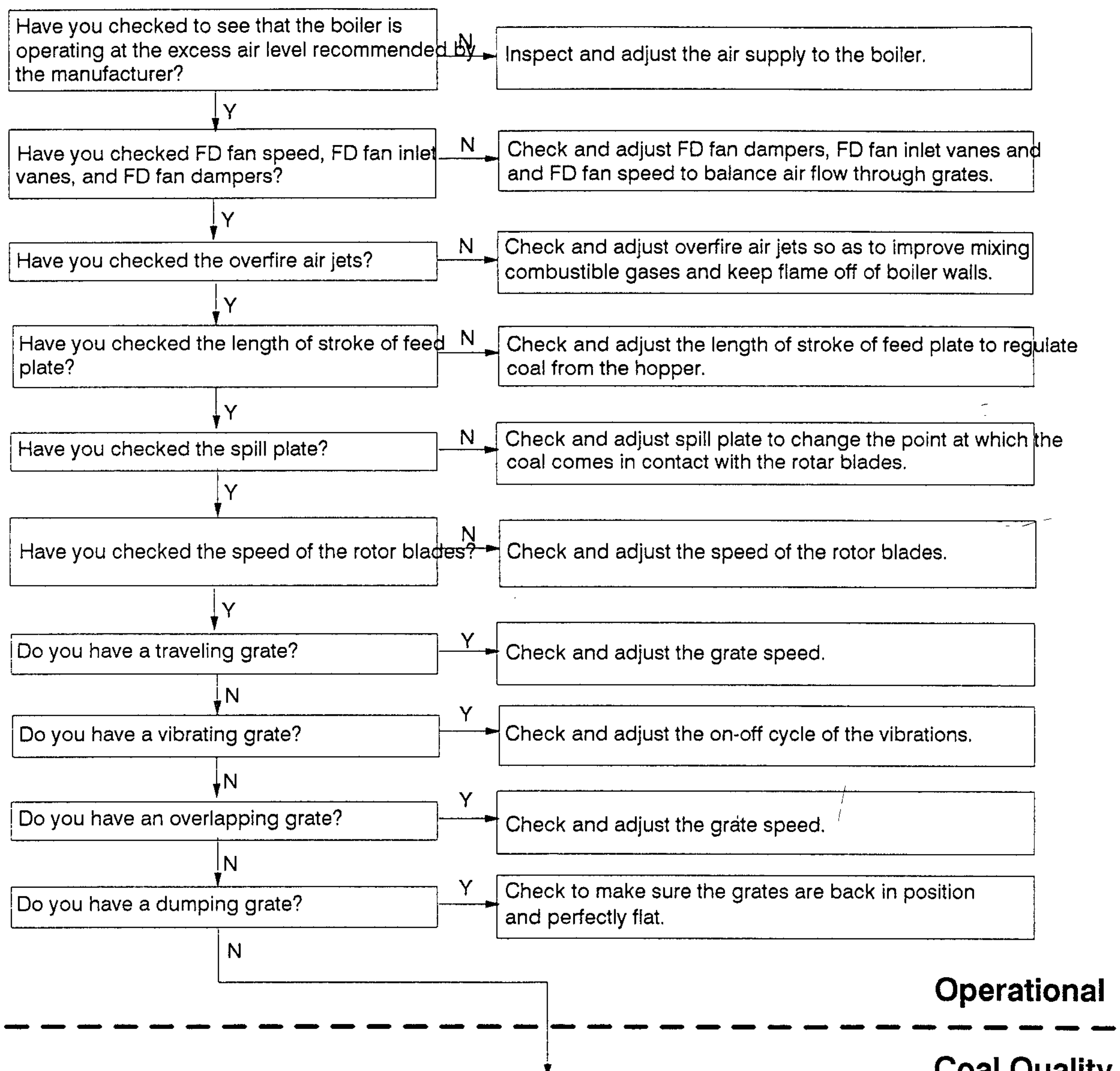
High Sulfur - Sulfur in the coal can react during the combustion process and form a corrosive deposit on heat transfer surfaces.

High Ash - Ash high in sodium and potassium can react during the combustion process to form a corrosive deposit on heat transfer surfaces.

Excess Fines - Fines high in ash -- sodium and potassium -- can react during the combustion process to form a corrosive deposit on heat transfer surfaces.

FIG2-69nb/2

FIGURE 2-70: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)



See next page for Coal Quality Section.

FIG2-70n/2

FIGURE 2-70 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on heat transfer surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

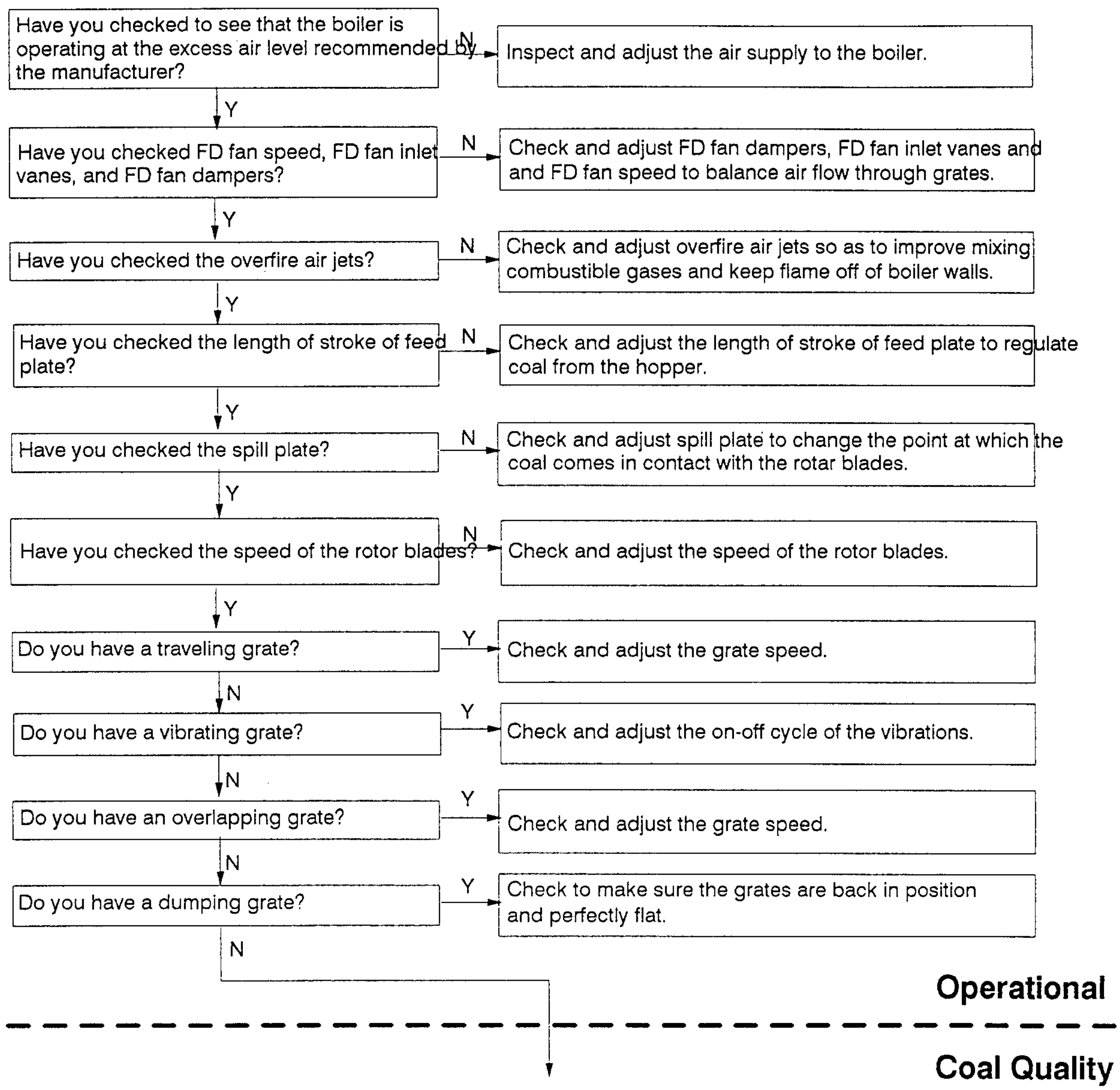
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away the surface.

FIG2-70nb/2

FIGURE 2-71: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Boiler Tubes and Water Walls)



See next page for Coal Quality Section.

FIG2-71n/2

FIGURE 2-71 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

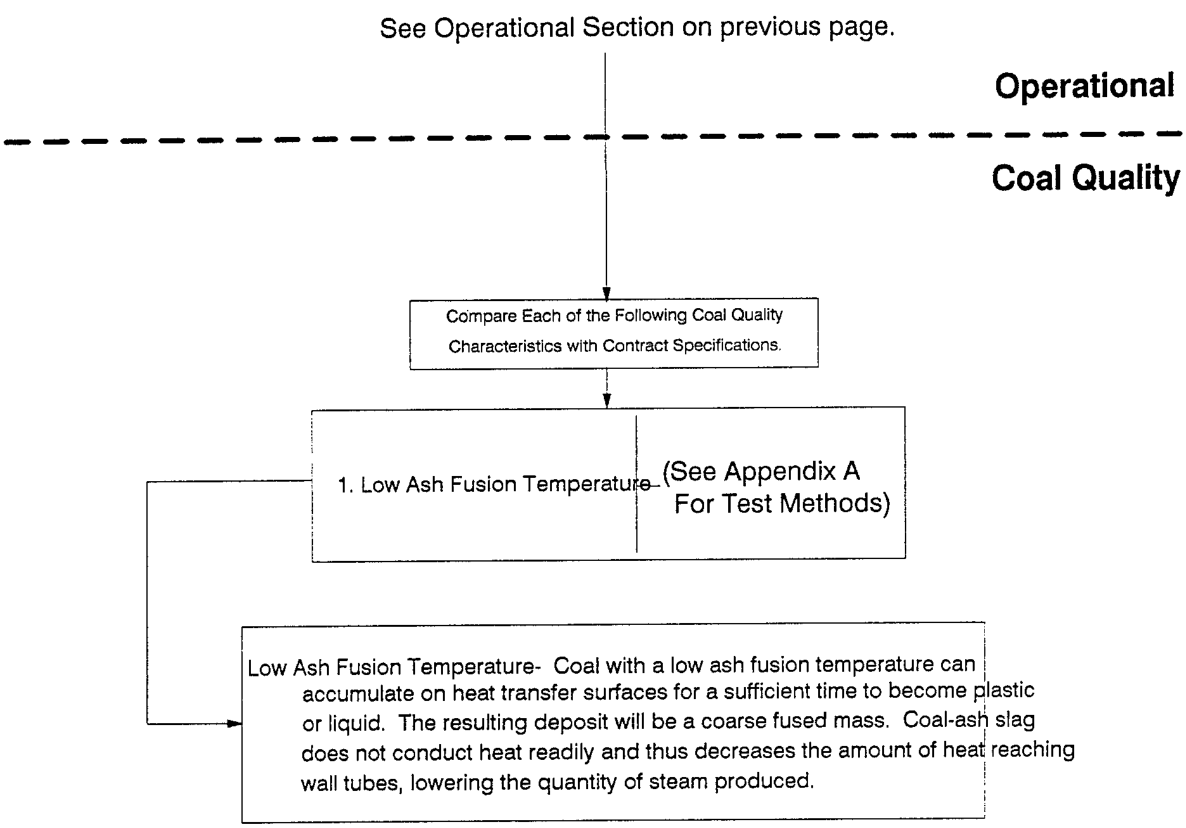
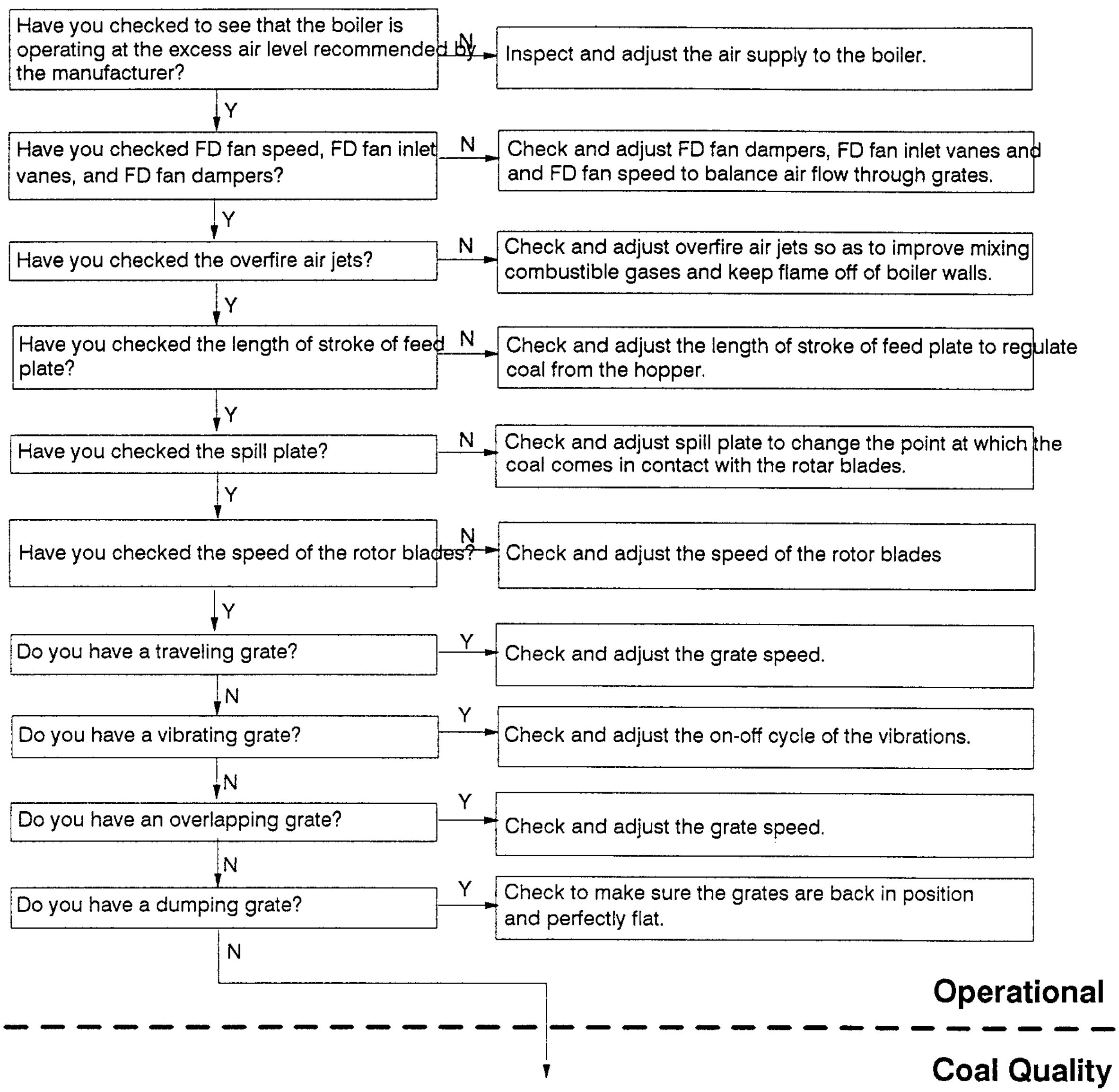


FIG2-71nb/2

FIGURE 2-72: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)



See next page for Coal Quality Section.

FIG2-72n/2

FIGURE 2-72 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Ash Fusion Temperature
2. High Free Alkalies

(See Appendix A For Test Methods)

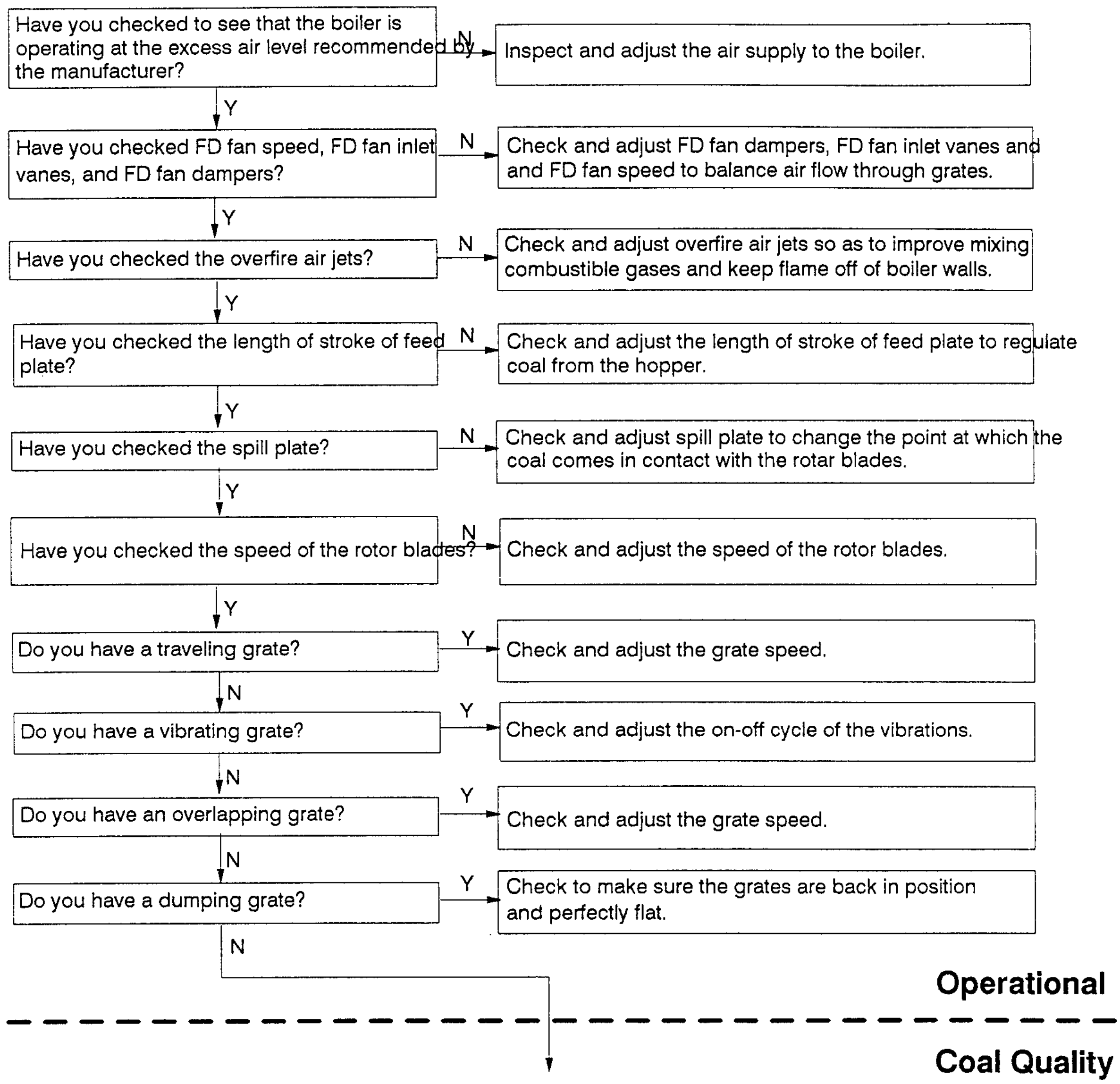
Low Ash Fusion Temperature - Coal with a low ash fusion temperature can accumulate on tube surfaces, insulating the metal so that not enough heat is transfered to raise the stream temperature to design level.

High Free Alkalies - Alkalies, specifically sodium and potassium, join with other elements in combinations that produce low ash fusion temperatures.

FIG2-72nb/3

FIGURE 2-73: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Baffles



See next page for Coal Quality Section.

FIG2-73r/3

FIGURE 2-73 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Corrosion Of The Baffles

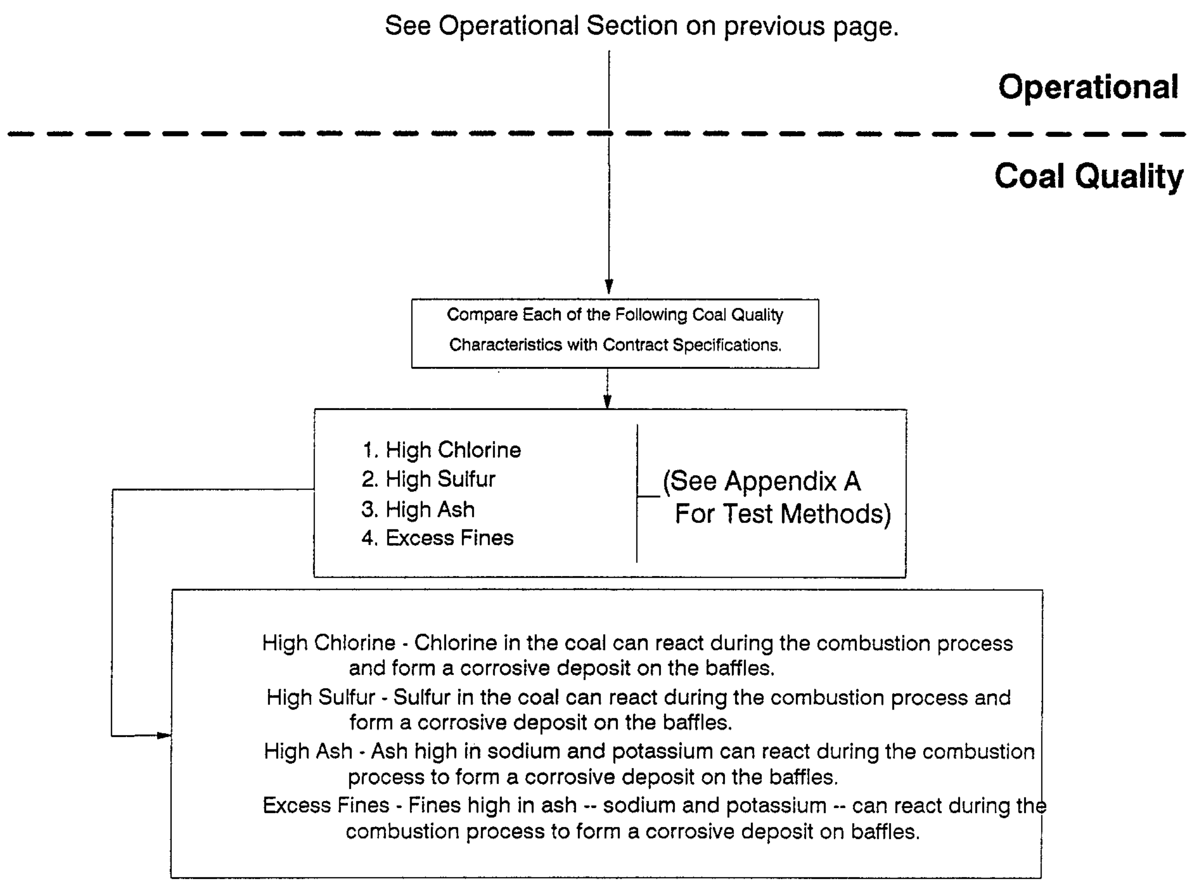
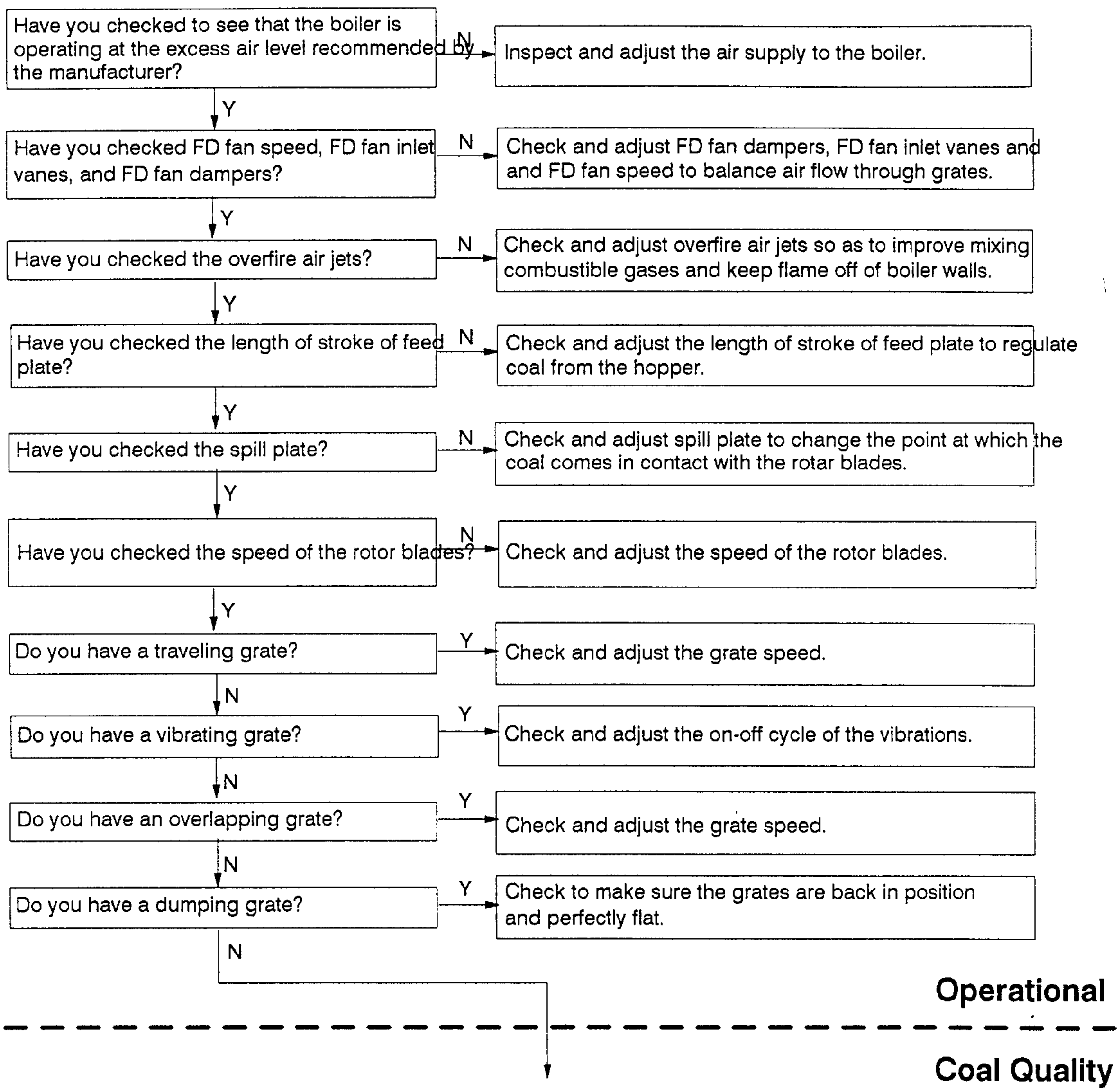


FIG2-73nb/3

FIGURE 2-74: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Baffles)



See next page for Coal Quality Section.

FIG2-74n/3

FIGURE 2-74 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Baffles)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on baffles eventually wearing away the surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the baffles eventually wearing away the surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

FIG2-74nb/3

FIGURE 2-75: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Baffles)

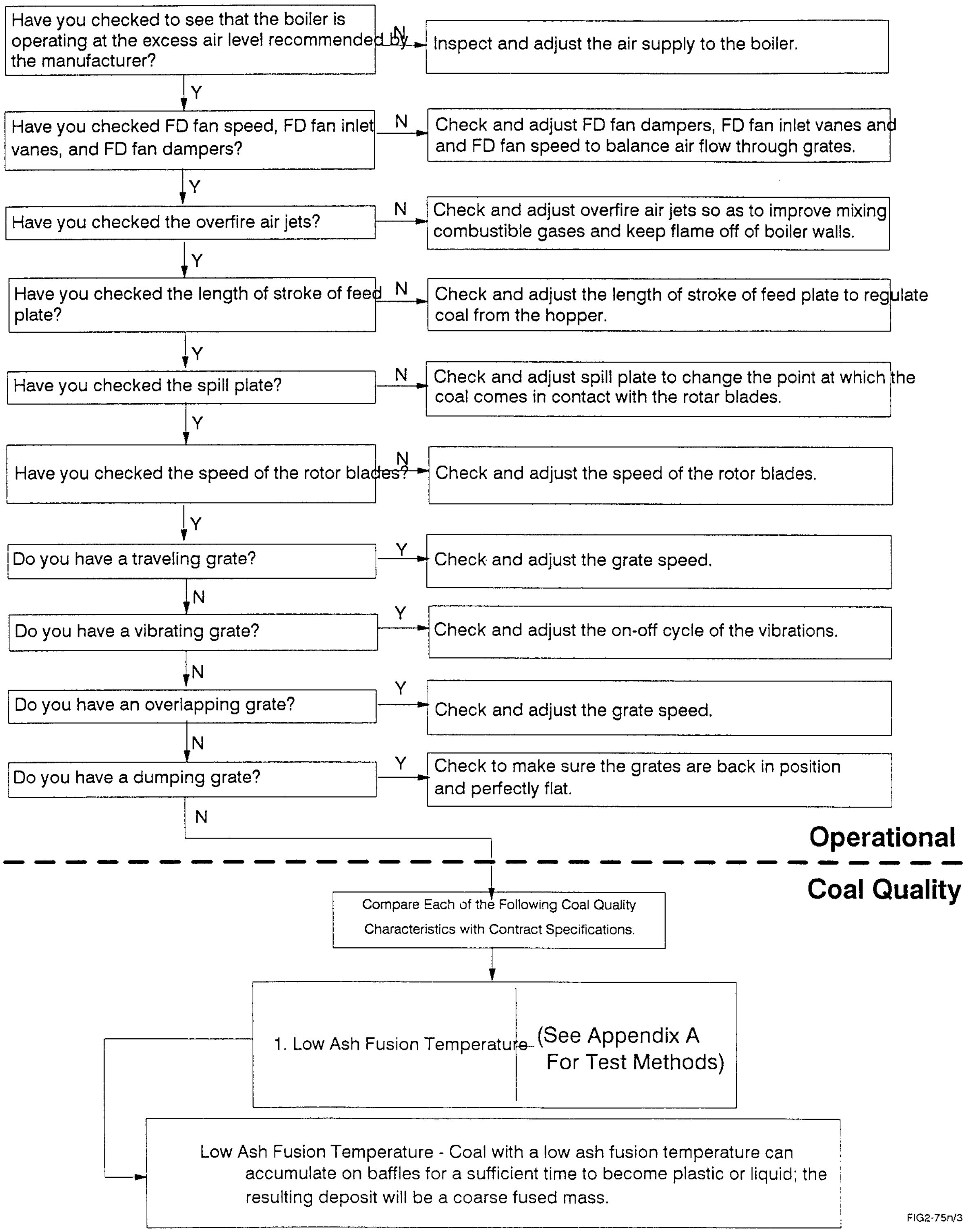
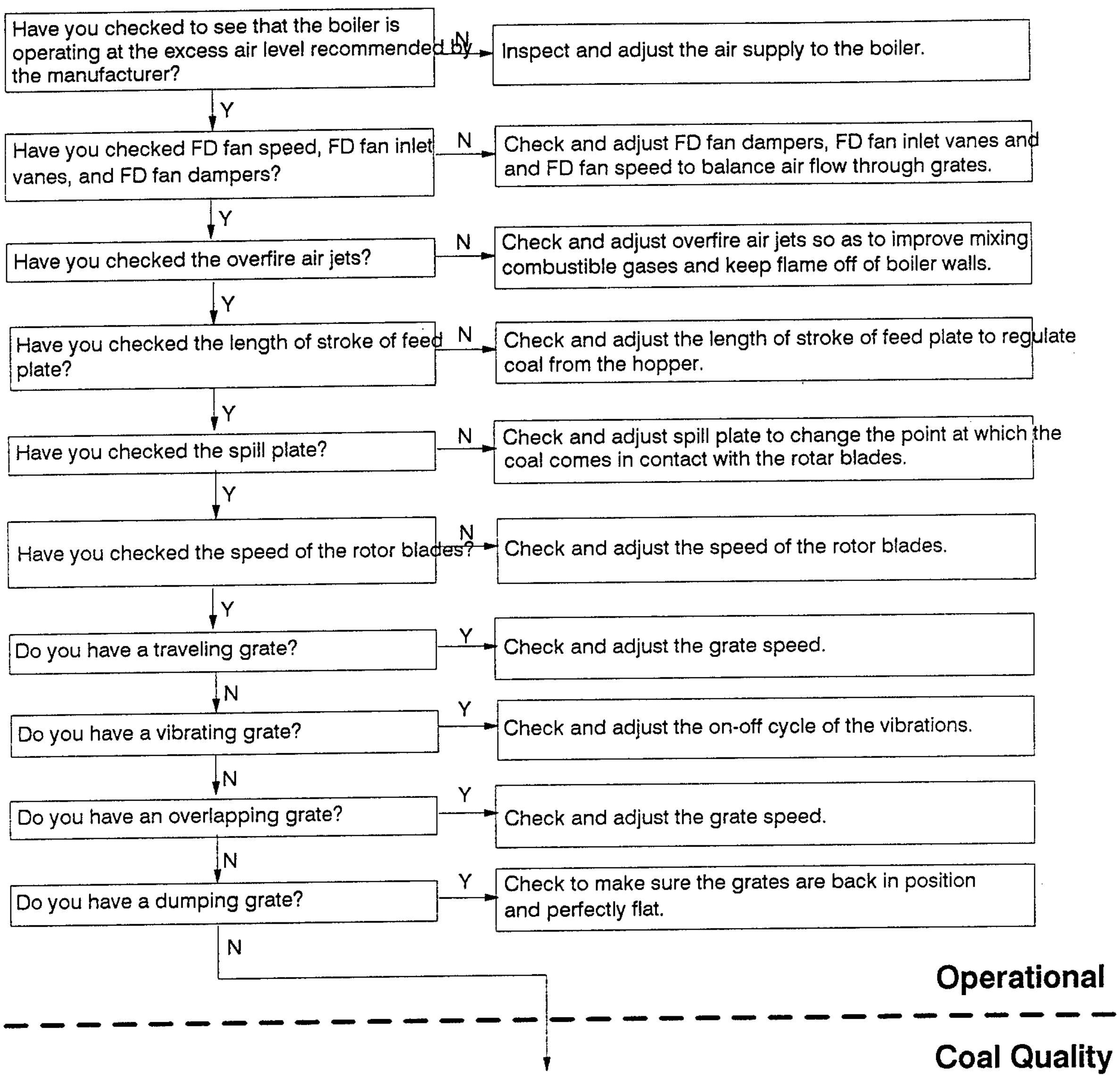


FIG2-75n/3

FIGURE 2-76: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of Heat Transfer Surfaces (Baffles)



See next page for Coal Quality Section.

FIG2-76n/3

FIGURE 2-76 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Baffles)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Ash Fusion Temperature
2. High Free Alkali

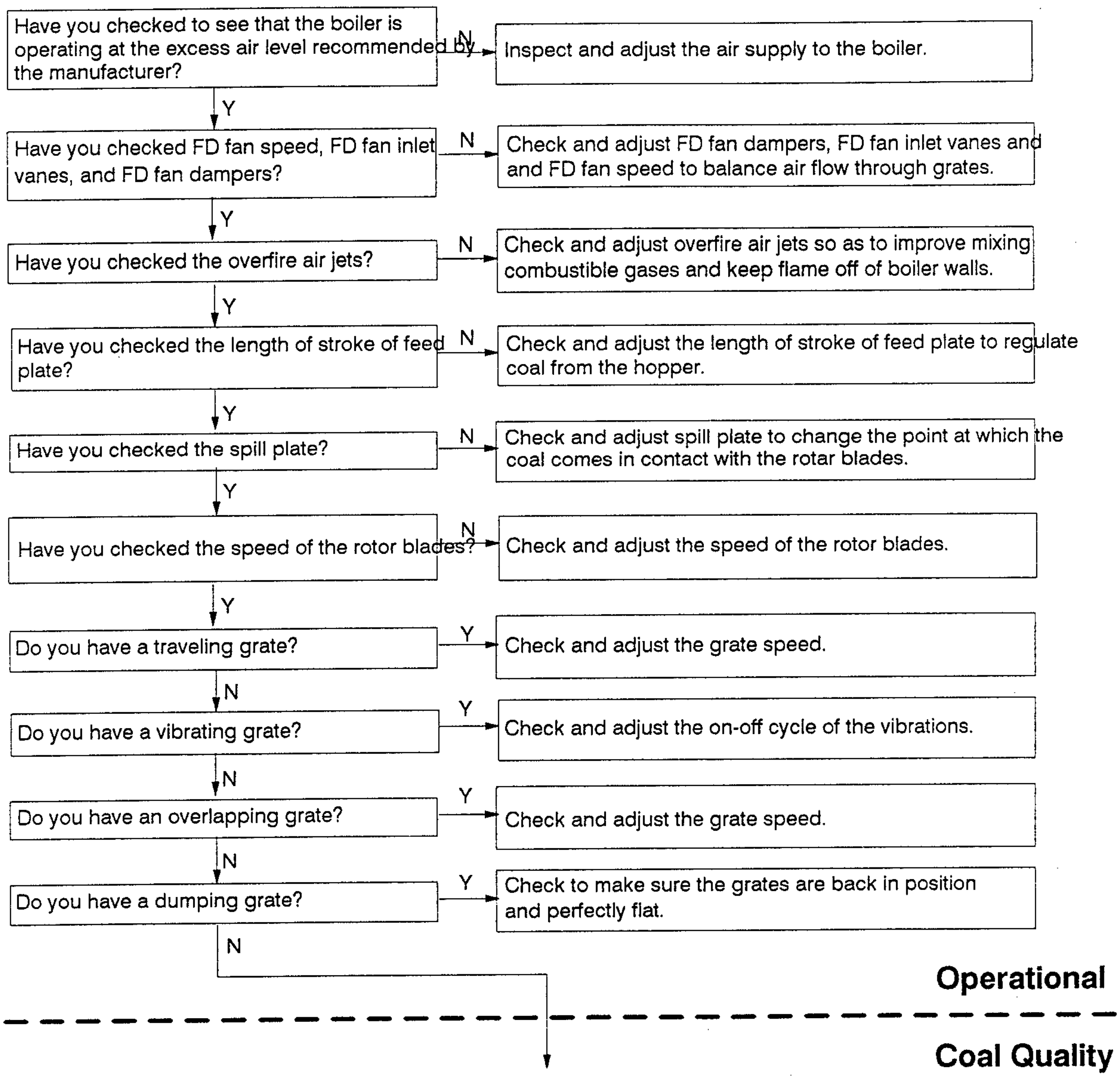
(See Appendix A For Test Methods)

Low Ash Fusion Temperature - Coal with a low ash fusion temperature can accumulate on baffles forming dense, adherent layers which can be difficult to remove except by manual cleaning.

High Free Alkalies - Alkalies, specifically sodium and potassium, join with other elements in combinations that produce low ash fusion temperatures.

FIG2-76nb/3

FIGURE 2-77: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity and Inability To Meet Load
(Forced Draft Fan)



See next page for Coal Quality Section.

FIG2-77n/3

FIGURE 2-77 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity and Inability To Meet Load
(Forced Draft Fan)

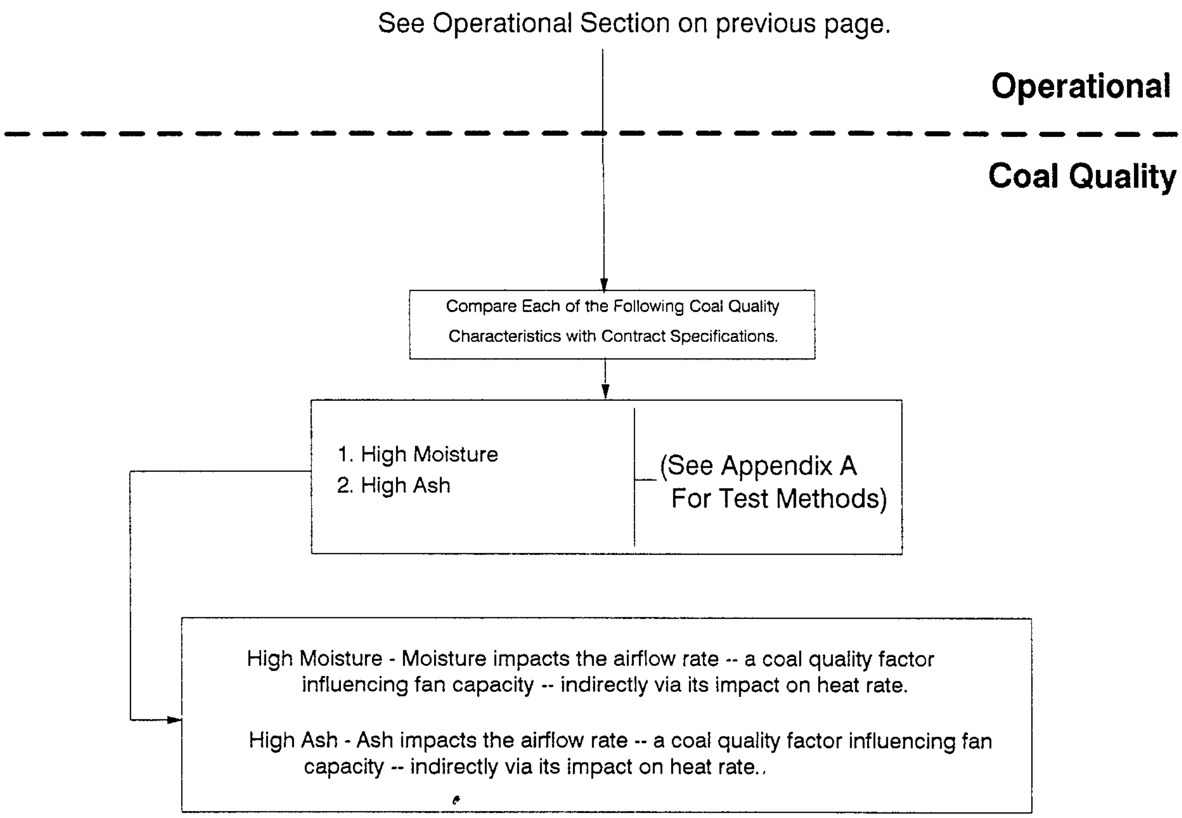
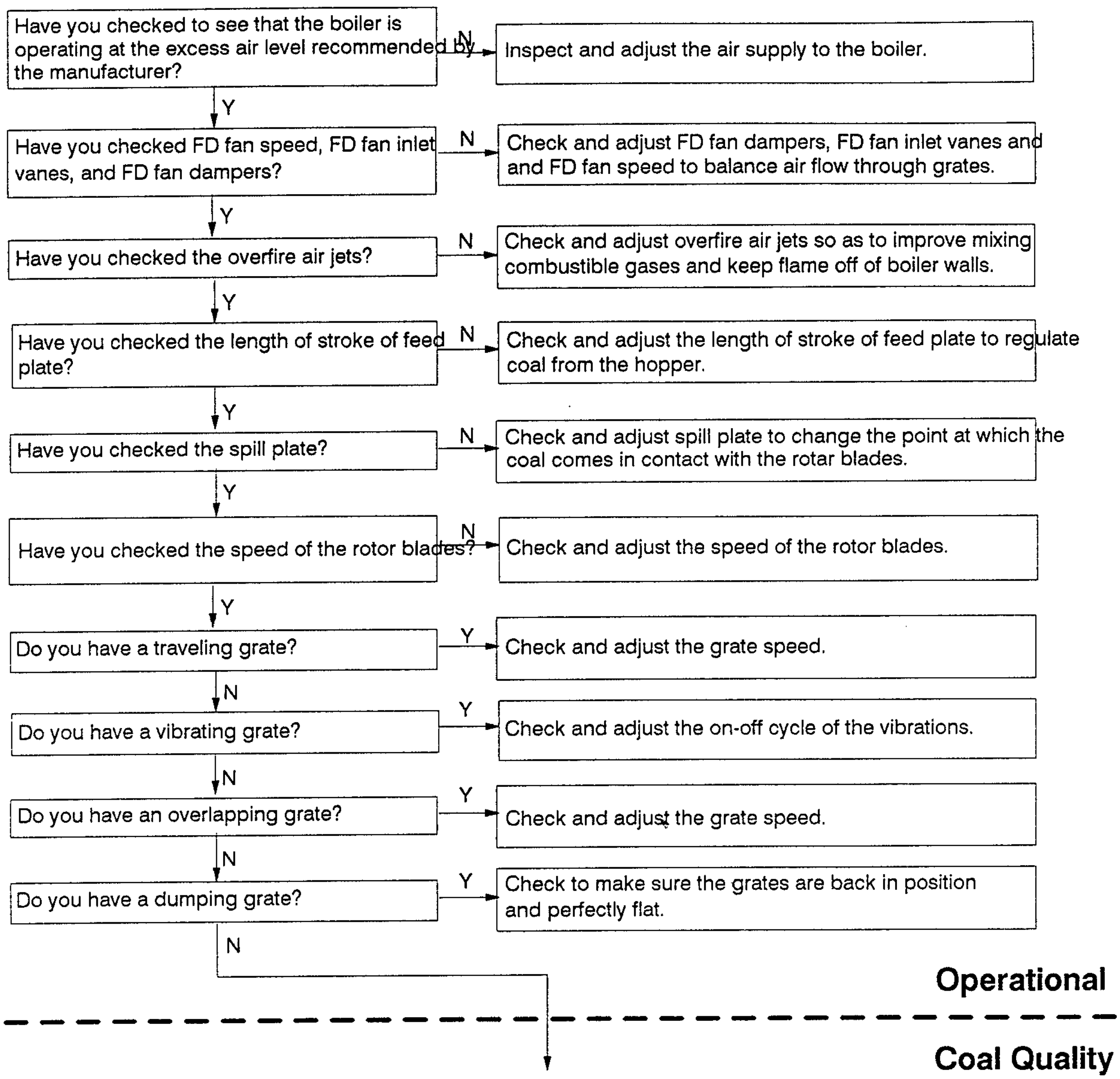


FIG2-77nb/3

FIGURE 2-78: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Forced Draft Fan



See next page for Coal Quality Section.

FIG2-78n/3

FIGURE 2-78 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Forced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG2-78nb/3

FIGURE 2-79: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Induced Draft Fan)

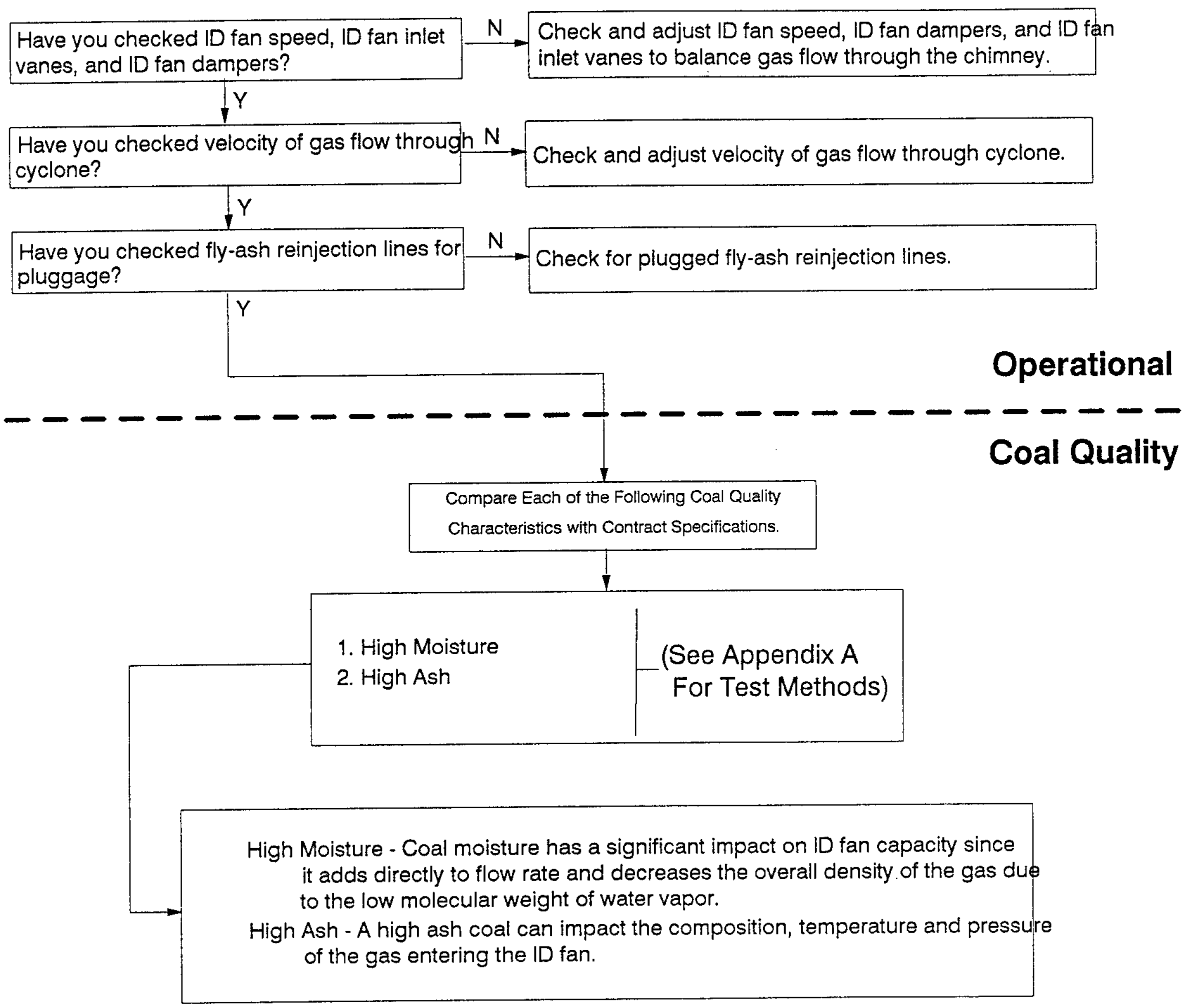


FIG2-79n/3

FIGURE 2-80: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Induced Draft Fan

- Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer?
  - N → Inspect and adjust the air supply to the boiler.
  - Y ↓
- Have you checked ID fan speed, ID fan inlet vanes, and ID fan dampers?
  - N → Check and adjust ID fan speed, ID fan dampers, and ID fan inlet vanes to balance gas flow through the chimney.
  - Y ↓
- Have you checked the overfire air jets?
  - N → Check and adjust overfire air jets so as to improve mixing combustible gases and keep flame off of boiler walls.
  - Y ↓
- Have you checked FD fan speed, FD fan inlet vanes, and FD fan dampers?
  - N → Check and adjust FD fan dampers, FD fan inlet vanes and FD fan speed to balance air flow through grates.
  - Y ↓
- Have you checked the length of stroke of feed plate?
  - N → Check and adjust the length of stroke of feed plate to regulate coal from the hopper.
  - Y ↓
- Have you checked the spill plate?
  - N → Check and adjust spill plate to change the point at which the coal comes in contact with the rotar blades.
  - Y ↓
- Have you checked the speed of the rotor blades?
  - N → Check and adjust the speed of the rotor blades.
  - Y ↓
- Do you have a traveling grate?
  - Y → Check and adjust the grate speed.
  - N ↓
- Do you have a vibrating grate?
  - Y → Check and adjust the on-off cycle of the vibrations.
  - N ↓
- Do you have an overlapping grate?
  - Y → Check and adjust the grate speed.
  - N ↓
- Do you have a dumping grate?
  - Y → Check to make sure the grates are back in position and perfectly flat.
  - N ↓

Operational

- - - - - - - - - - - - - - - - - - - -

Coal Quality

See next page for Coal Quality Section.

FIG2-80n/3

FIGURE 2-80 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Chlorine
2. High Sulfur
3. High Ash
4. Excess Fines

(See Appendix A For Test Methods)

High Chlorine - Chlorine in the coal can react during the combustion process and form a corrosive deposit on the induced draft fan.

High Sulfur - Sulfur in the coal can react during the combustion process and form a corrosive deposit on the induced draft fan.

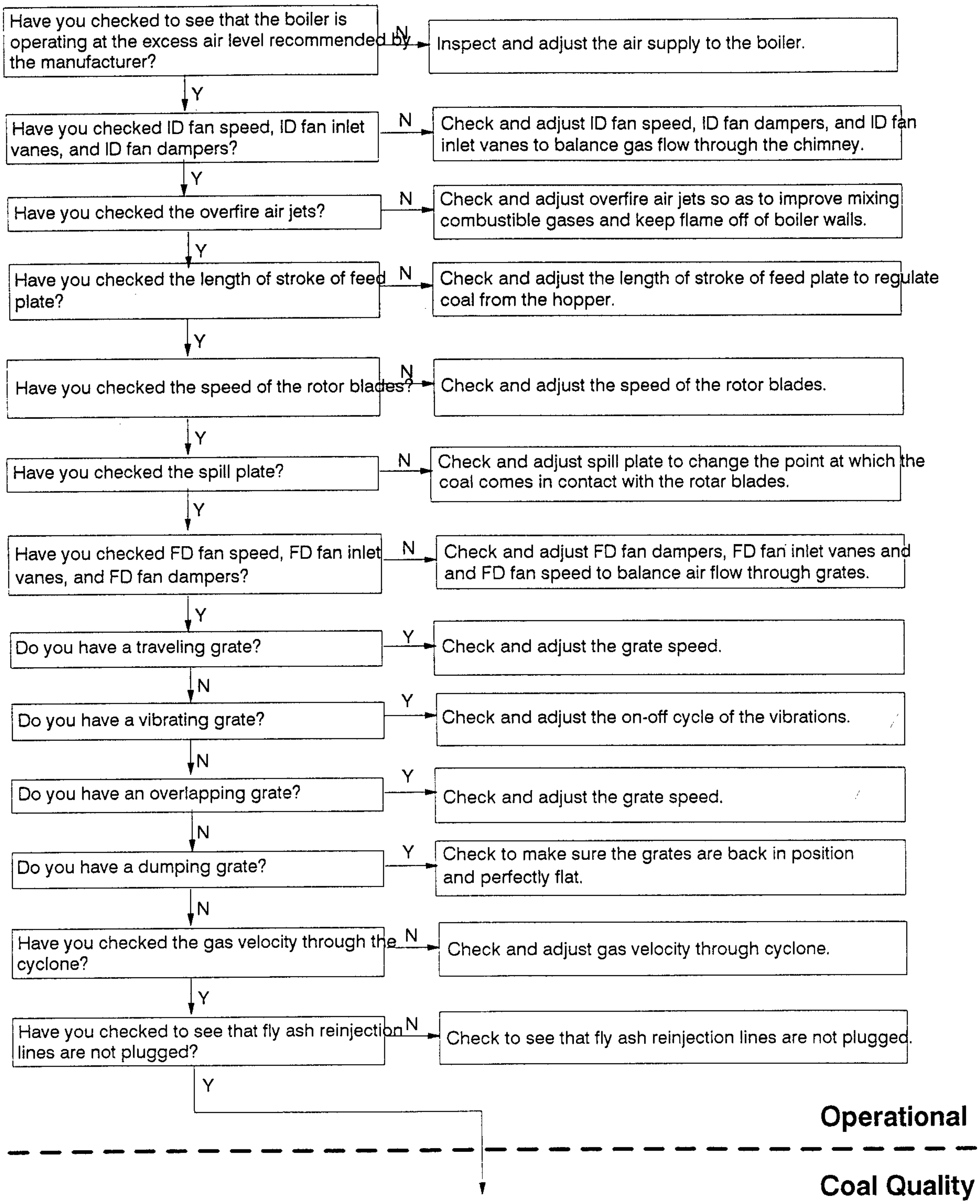
High Ash - Ash high in sodium and potassium can react during the combustion process to form a corrosive deposit on the induced draft fan.

Excess Fines - Fines high in ash -- sodium and potassium -- can react during the combustion process to form a corrosive deposit on induced draft fan.

FIG2-80nb/3

FIGURE 2-81: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan



See next page for Coal Quality Section.

FIG2-81n/3

FIGURE 2-81 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

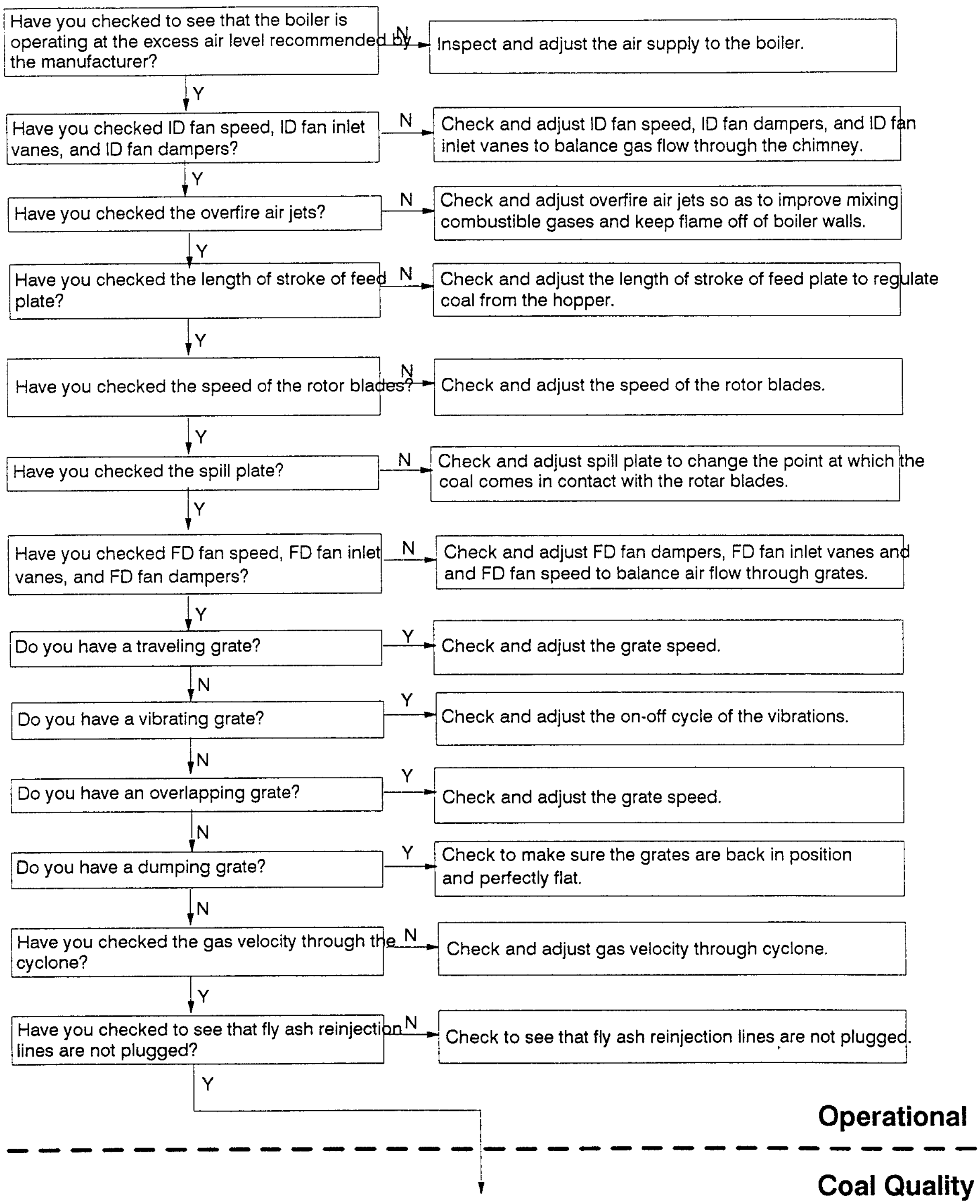
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG2-81nb/3

FIGURE 2-82: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Induced Draft Fan



See next page for Coal Quality Section.

FIGURE 2-82 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

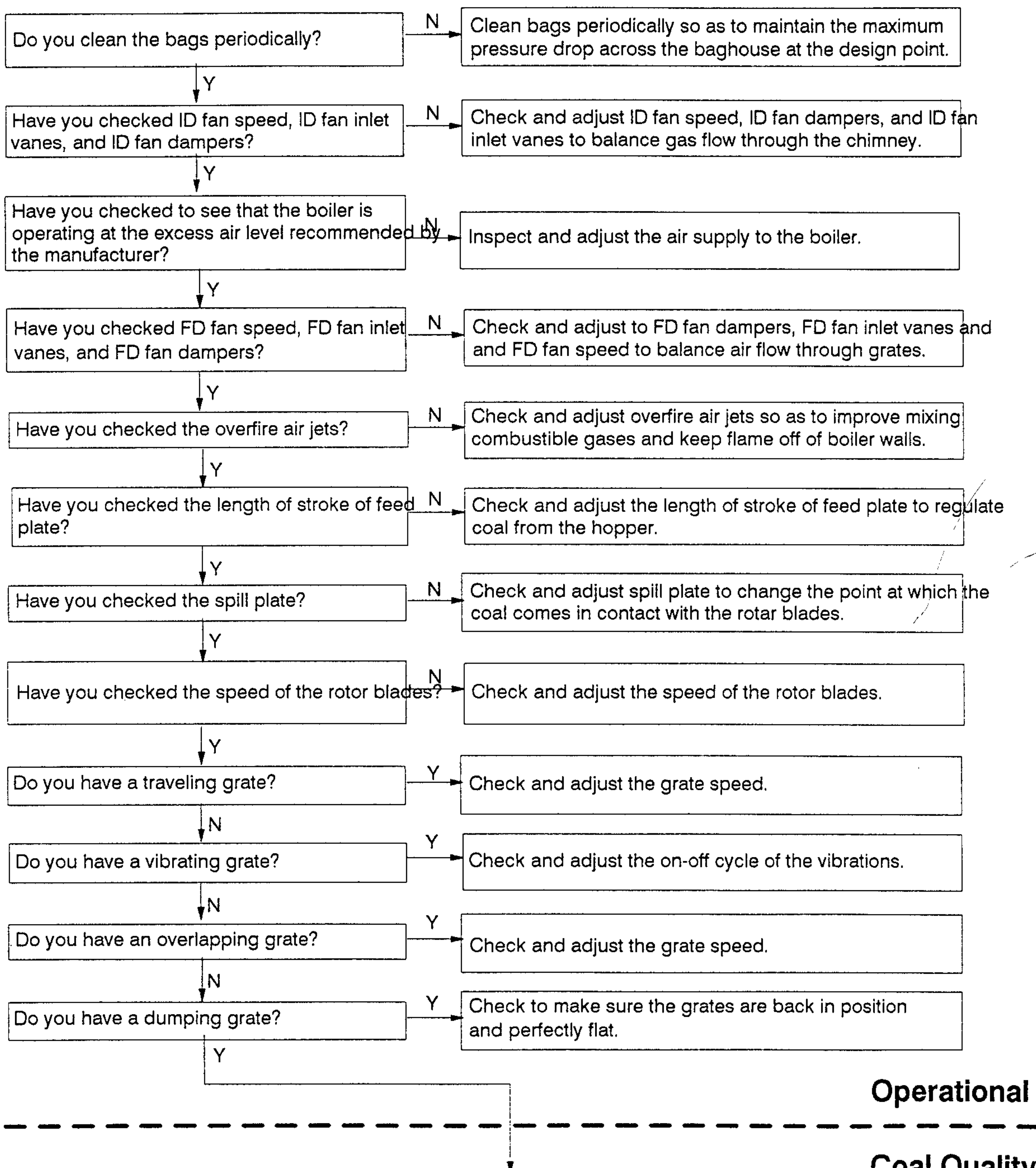
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG2-82nb/3

FIGURE 2-83: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout Of The Particulate Removal System (Baghouse)



See next page for Coal Quality Section.

FIG2-83n/3

FIGURE 2-83 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Particulate Removal System
(Baghouse)

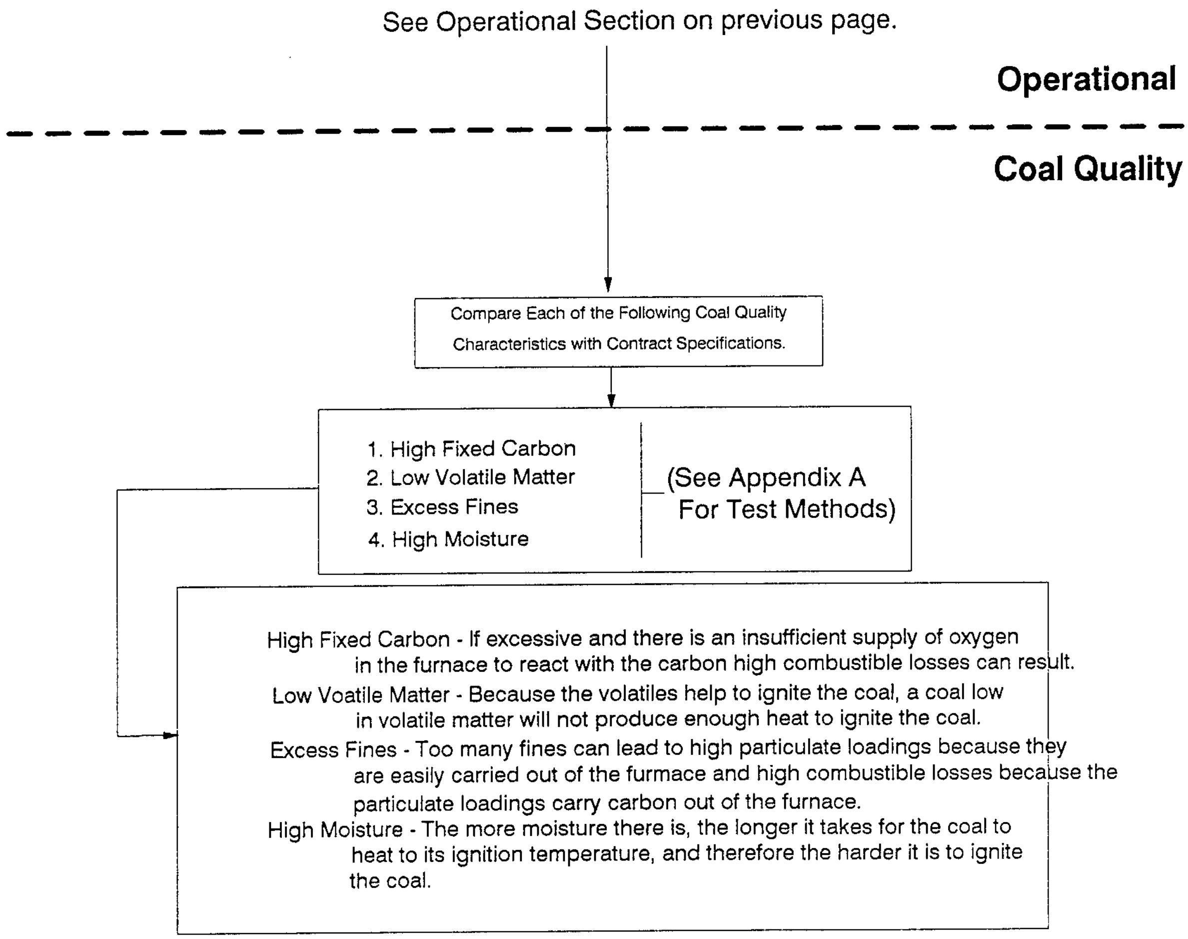
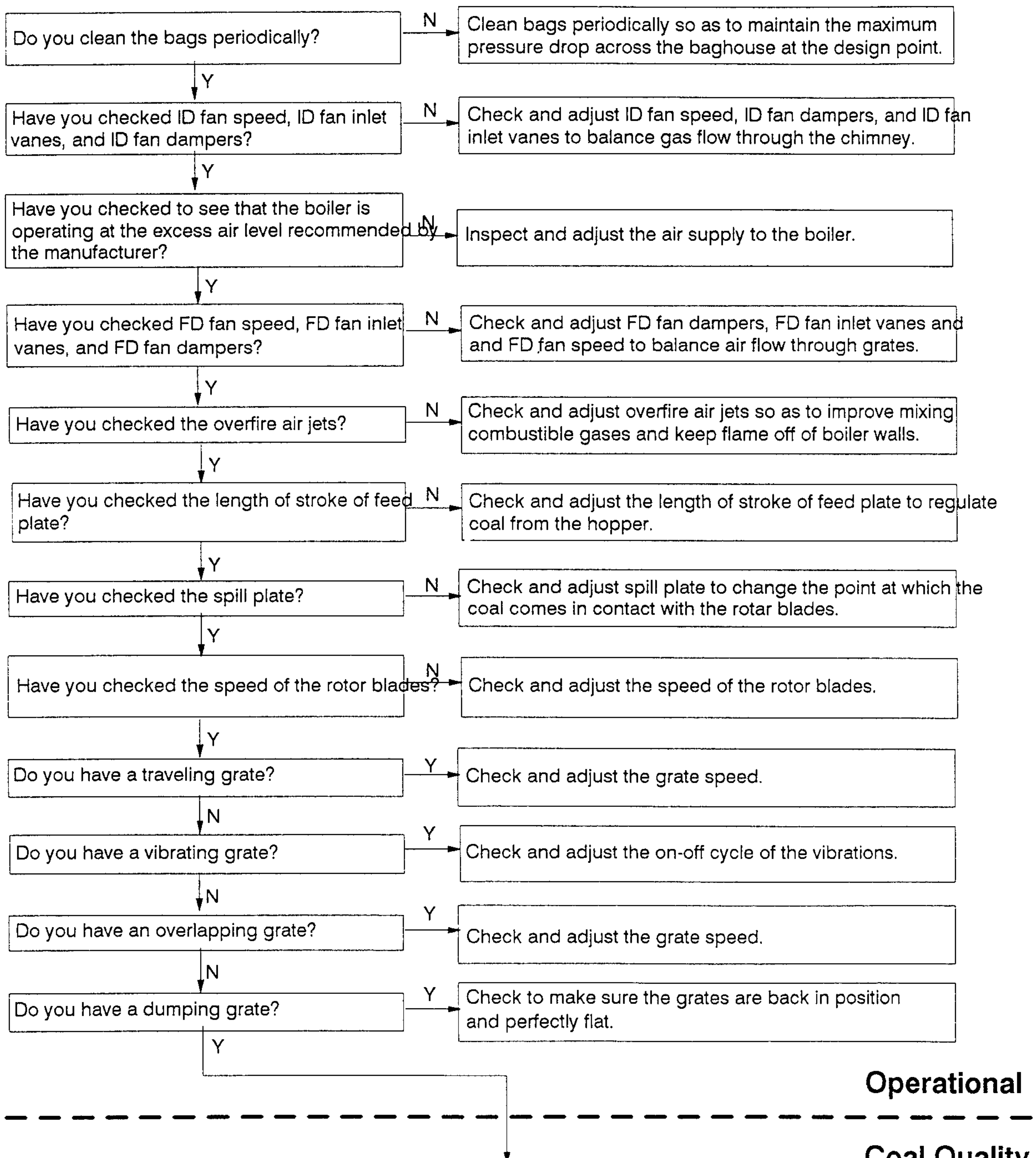


FIG2-83nb/3

FIGURE 2-84: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Baghouse)



See next page for Coal Quality Section.

FIG2-84n/3

FIGURE 2-84 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Baghouse)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the chimney.

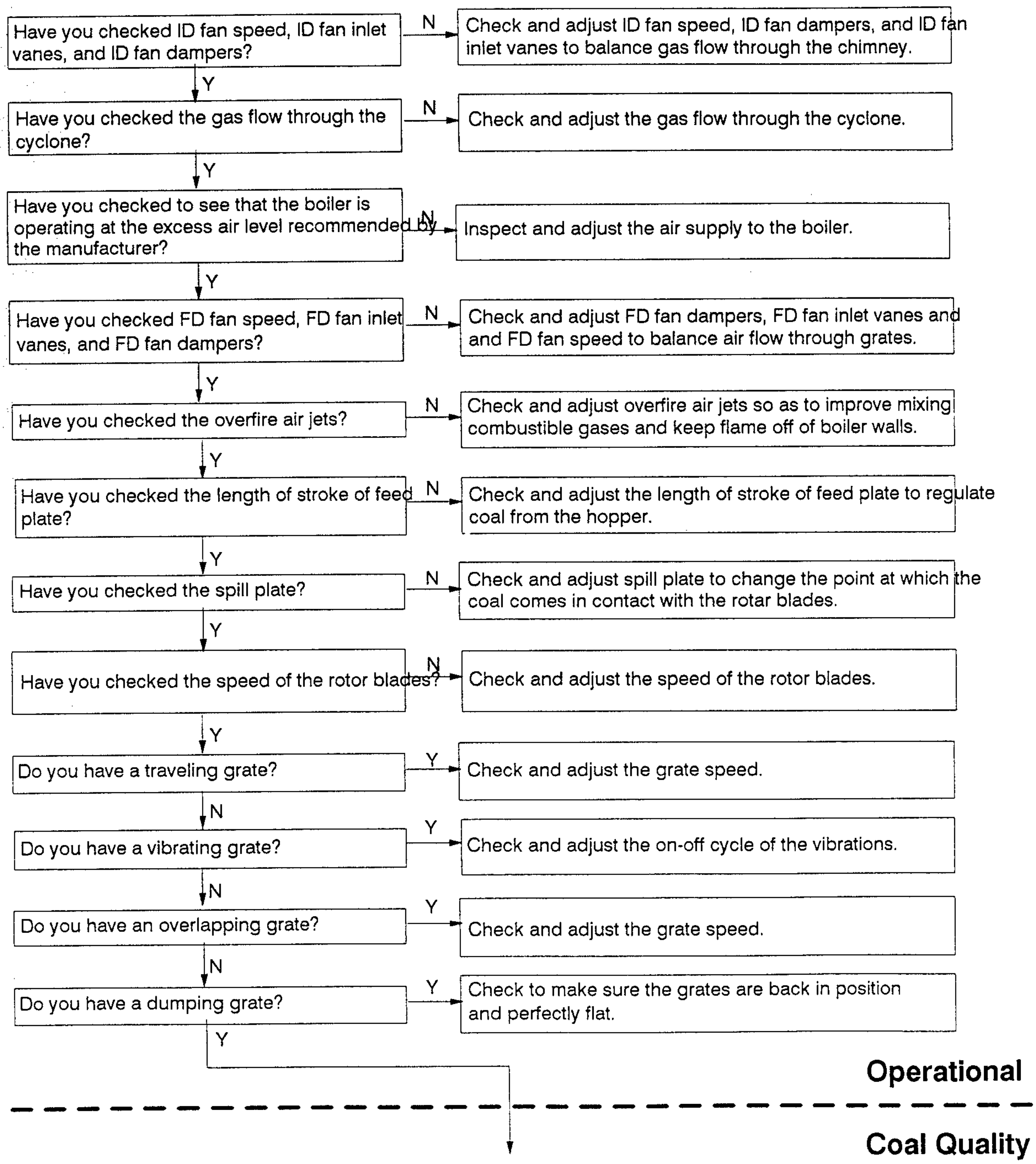
High Ash - Ash can get entrained in the flue gas and get carried out the chimney.

Low Moisture - Dry fine coal particles can become entrained in the flue gas and get carried out the chimney.

FIG2-84nb/3

FIGURE 2-85: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout Of The Particulate Removal System (Cyclone Dust Collector)



See next page for Coal Quality Section.

FIG2-85n/3

FIGURE 2-85 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Carbon Burnout Of The Particulate Removal System (Cyclone Dust Collector)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

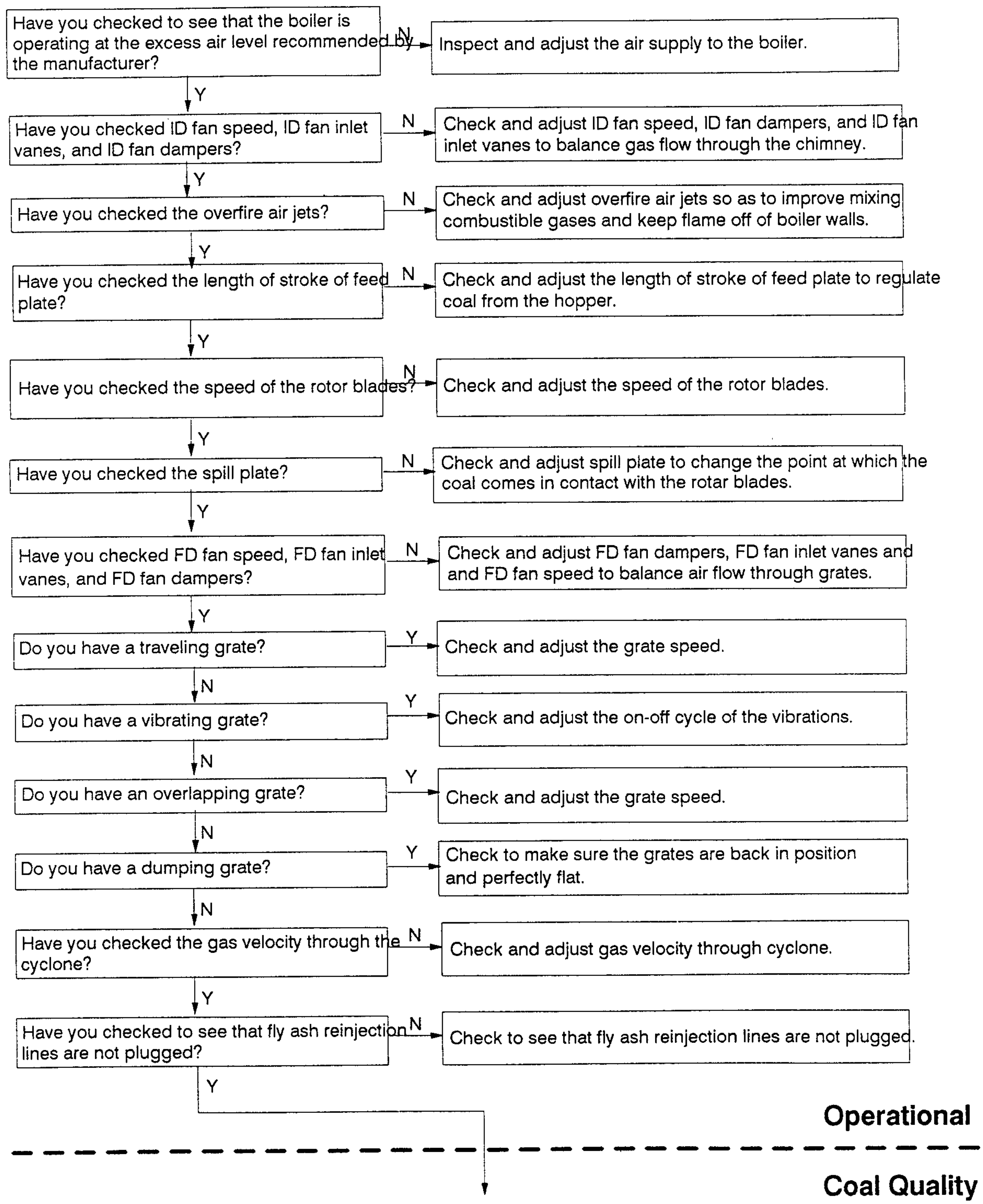
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG2-85nb/3

FIGURE 2-86: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion In The Particulate Removal System
(Cyclone)



See next page for Coal Quality Section.

FIG2-86r/3

FIGURE 2-86 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion In The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

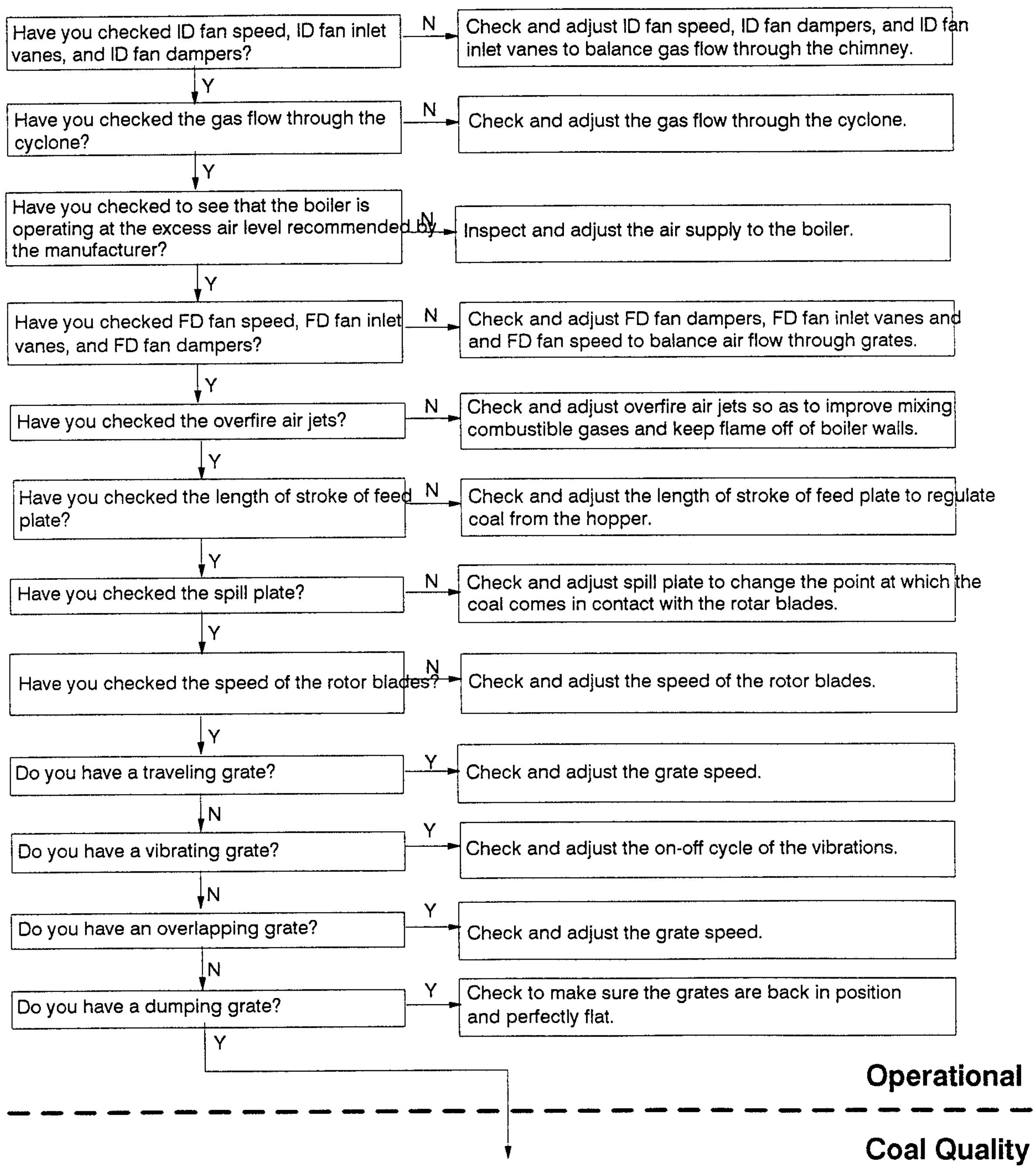
Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG2-86nb/3

FIGURE 2-87: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Cyclone)



See next page for Coal Quality Section.

FIG2-87n/3

FIGURE 2-87 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG2-87nb/3

FIGURE 2-88: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System (Electrostatic Precipitator)

Have you checked the gas velocity through the precipitator?	N	Check and adjust the gas velocity through the precipitator.
Have you checked the applied voltage across the collecting plates?	N	Check and adjust the applied voltage across the collecting plates.
Have you checked the corona strength?	N	Check the corona strength.
Have you checked ID fan speed, ID fan inlet vanes, and ID fan dampers?	N	Check and adjust ID fan speed, ID fan dampers, and ID fan inlet vanes to balance gas flow through the chimney.
Have you checked the gas flow through the cyclone?	N	Check and adjust the gas flow through the cyclone.
Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer?	N	Inspect and adjust the air supply to the boiler.
Have you checked FD fan speed, FD fan inlet vanes, and FD fan dampers?	N	Check and adjust FD fan dampers, FD fan inlet vanes and and FD fan speed to balance air flow through grates.
Have you checked the overfire air jets?	N	Check and adjust overfire air jets so as to improve mixing combustible gases and keep flame off of boiler walls.
Have you checked the length of stroke of feed plate?	N	Check and adjust the length of stroke of feed plate to regulate coal from the hopper.
Have you checked the spill plate?	N	Check and adjust spill plate to change the point at which the coal comes in contact with the rotar blades.
Have you checked the speed of the rotor blades?	N	Check and adjust the speed of the rotor blades.
Do you have a traveling grate?	Y	Check and adjust the grate speed.
Do you have a vibrating grate?	Y	Check and adjust the on-off cycle of the vibrations.
Do you have an overlapping grate?	Y	Check and adjust the grate speed.
Do you have a dumping grate?	Y	Check to make sure the grates are back in position and perfectly flat.

(Each "Y" answer to the questions "Have you checked…" leads to the next question; each "N" answer to "Do you have…" leads to the next question. "N" to "Do you have a dumping grate?" leads to the Coal Quality section.)

Operational

Coal Quality

See next page for Coal Quality Section.

FIG2-88n/4

FIGURE 2-89 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with eventually wearing away the metal surface.

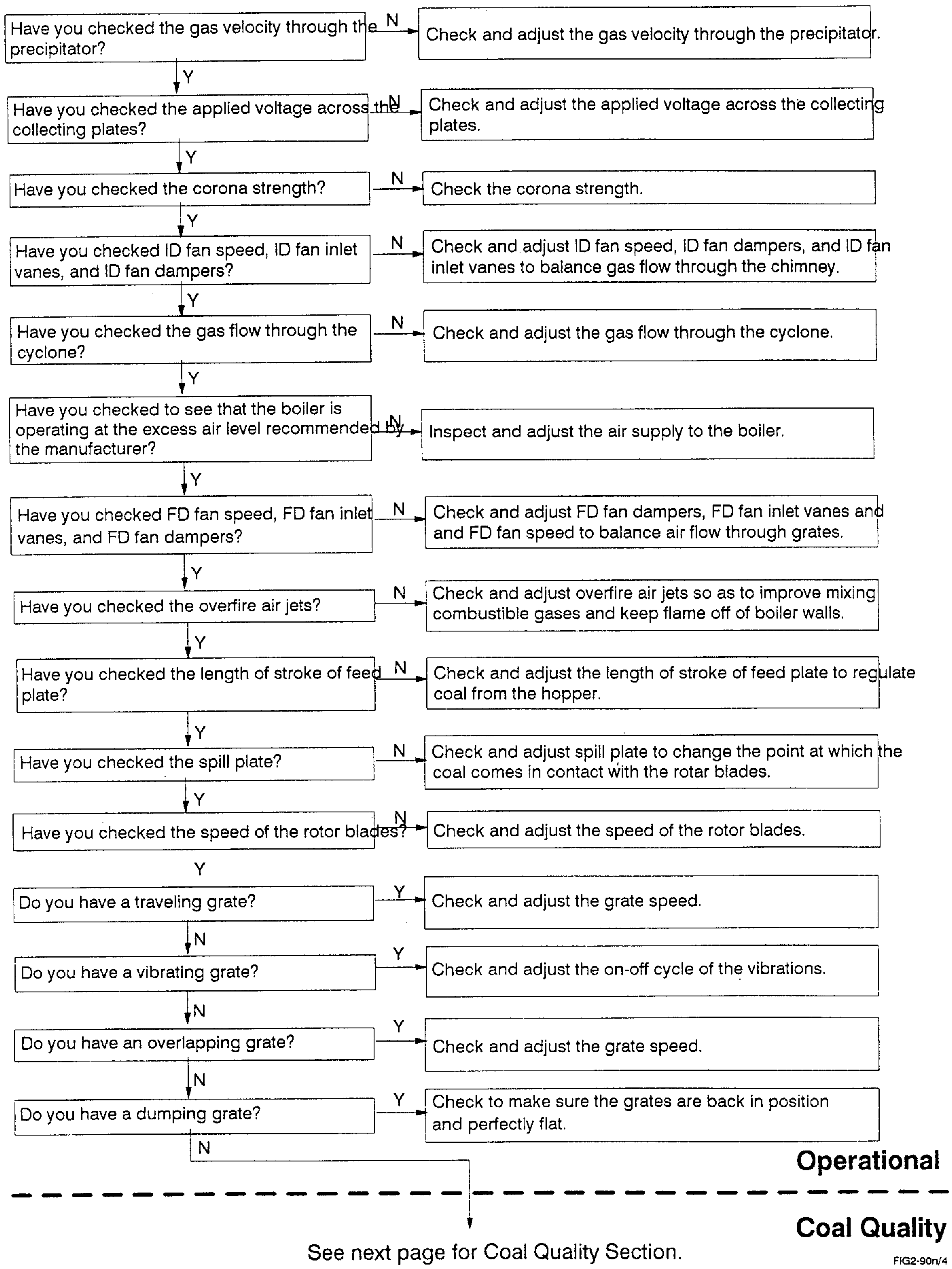
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with and eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with and wear away metal surfaces.

FIG2-89nb/3

FIGURE 2-90: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions Of The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIGURE 2-91 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Fly-Ash Recycle

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

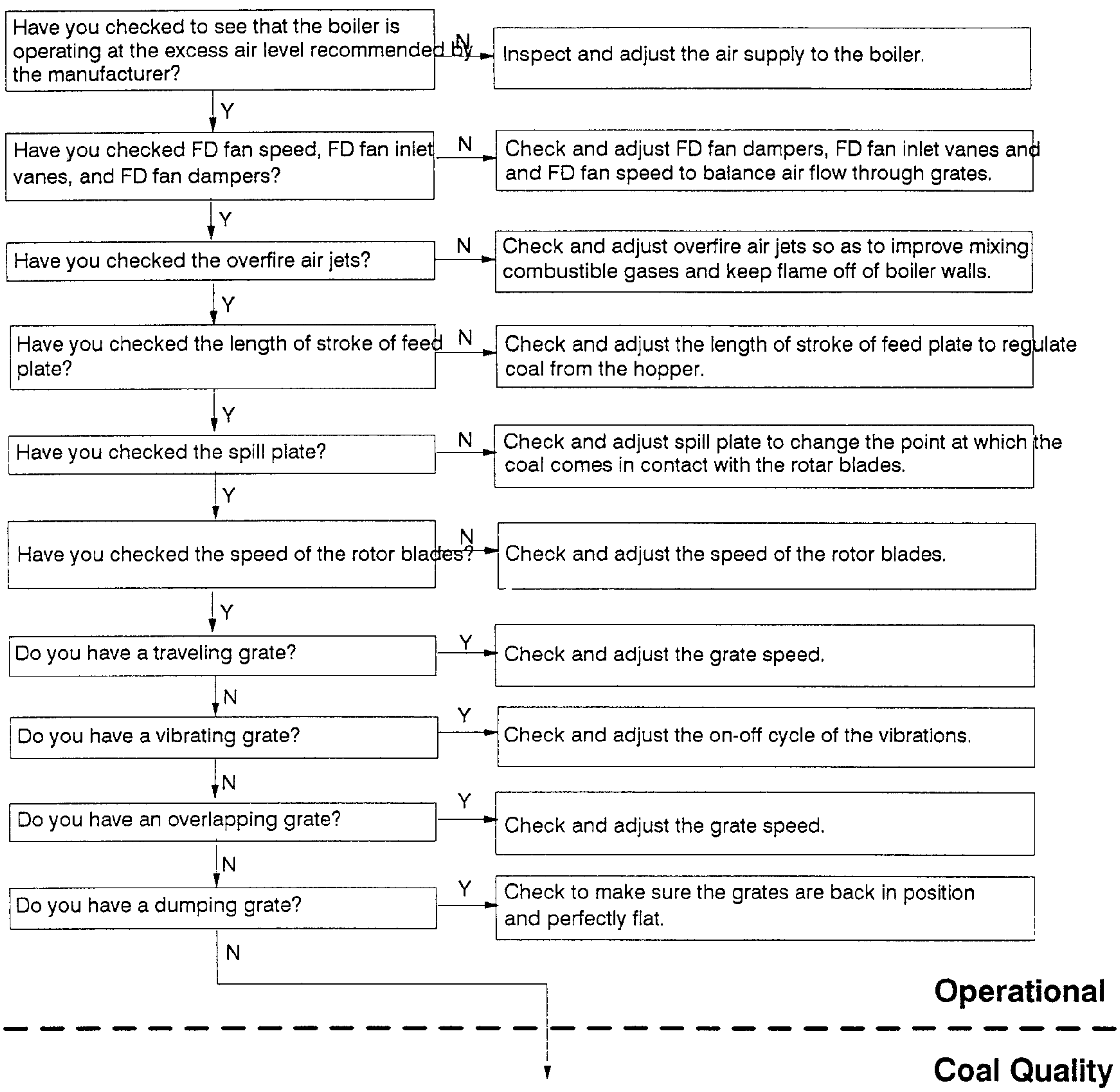
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG2-91nb/3

FIGURE 2-92: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Clinkers In The Ash Pit/Hopper



See next page for Coal Quality Section.

FIG2-92n/3

FIGURE 2-92 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Clinkers In The Ash Pit/Hopper

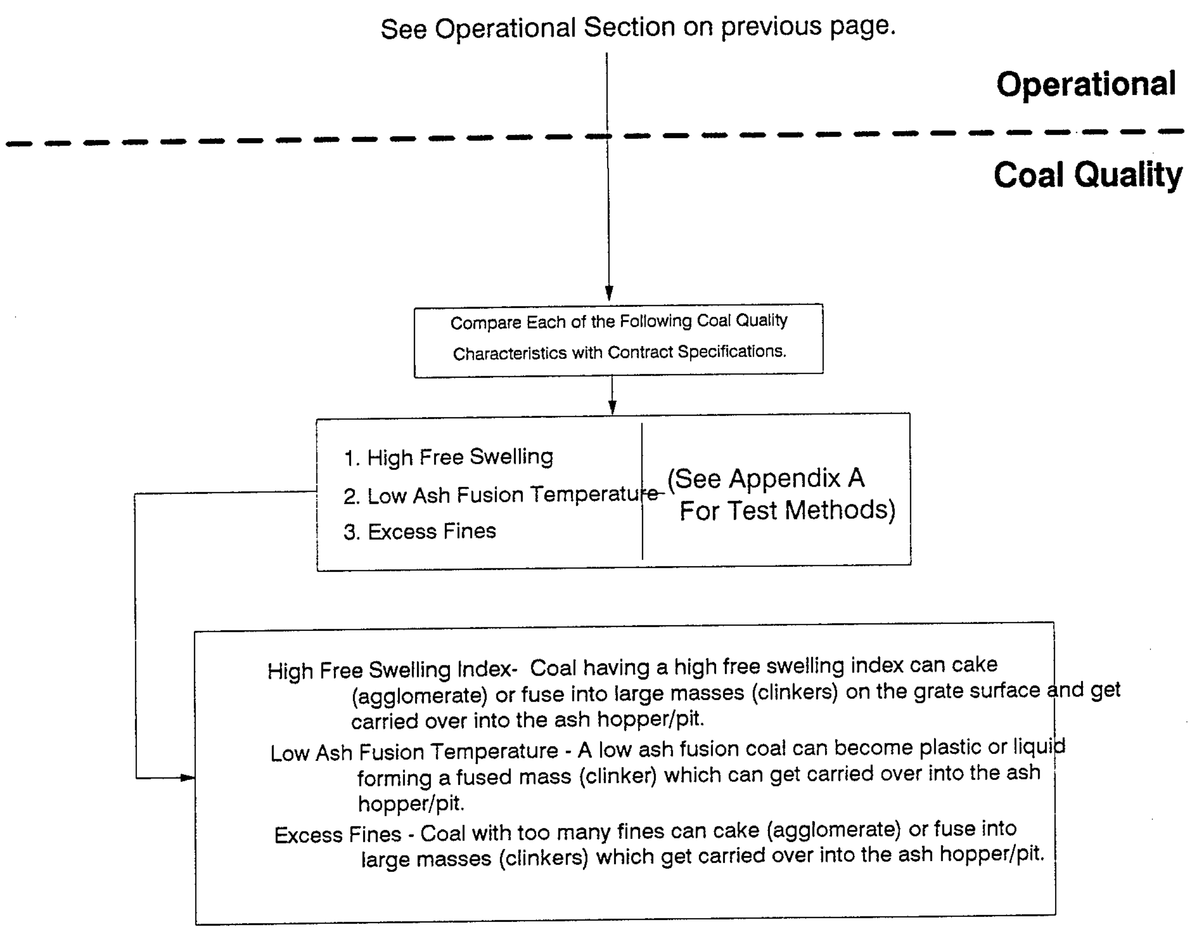
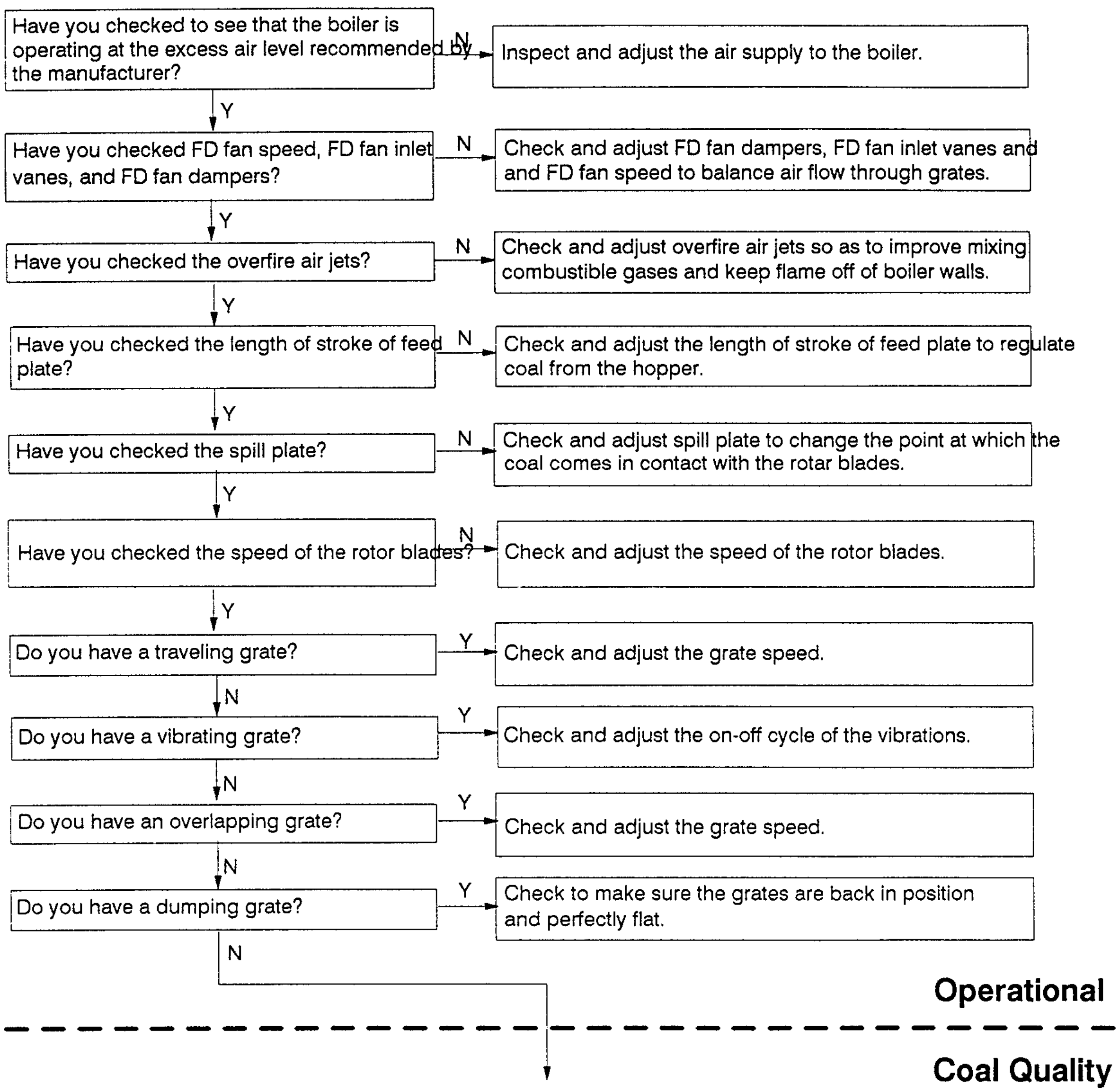


FIG2-92nb/3

FIGURE 2-93: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Ash Hopper/Pit



See next page for Coal Quality Section.

FIG2-93n/3

FIGURE 2-93 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Ash Hopper/Pit

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

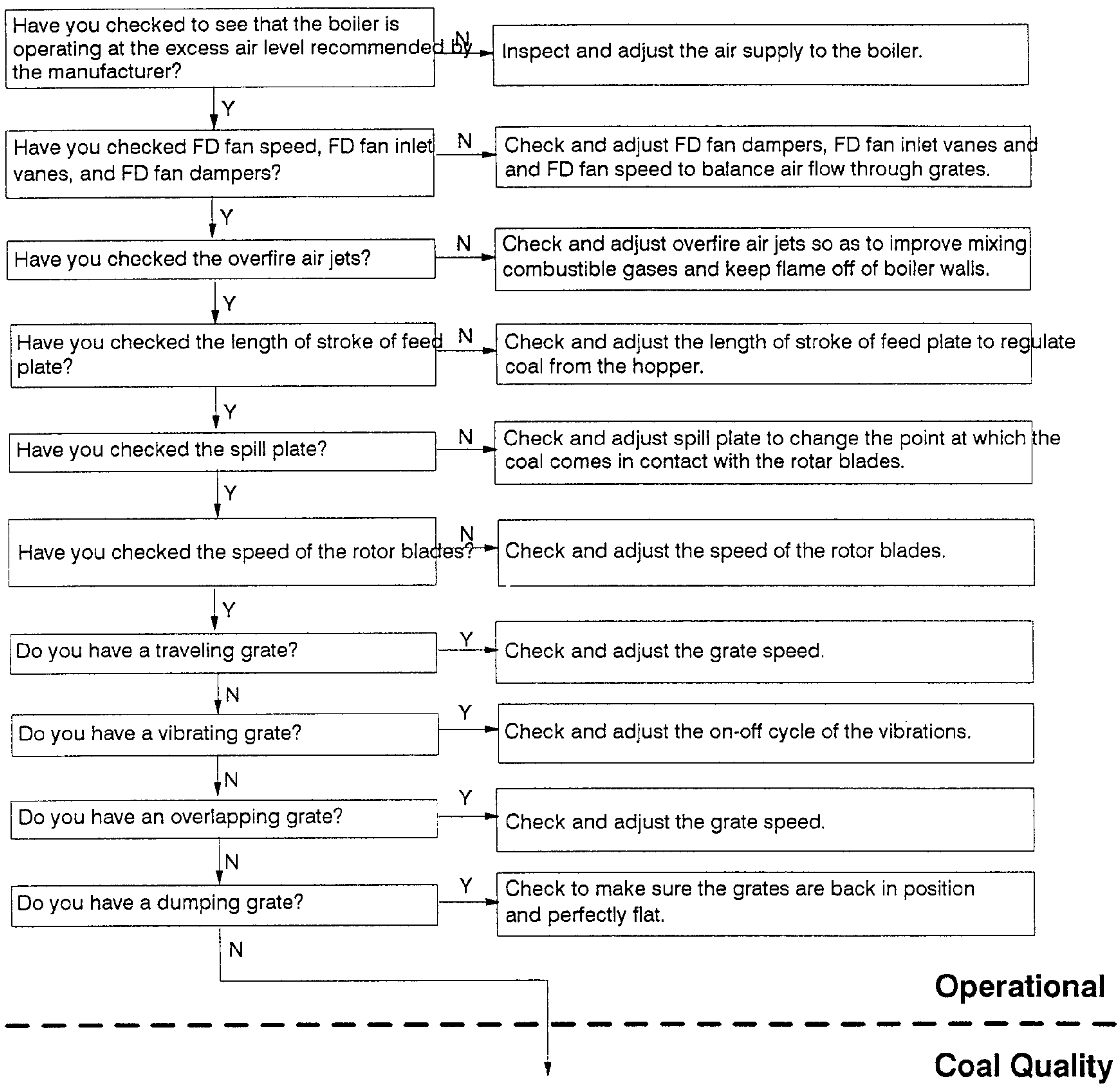
Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG2-93nb/3

FIGURE 2-94: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Stack/Chimney



See next page for Coal Quality Section.

FIG2-94n/4

FIGURE 2-94 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For Corrosion Of The Stack/Chimney

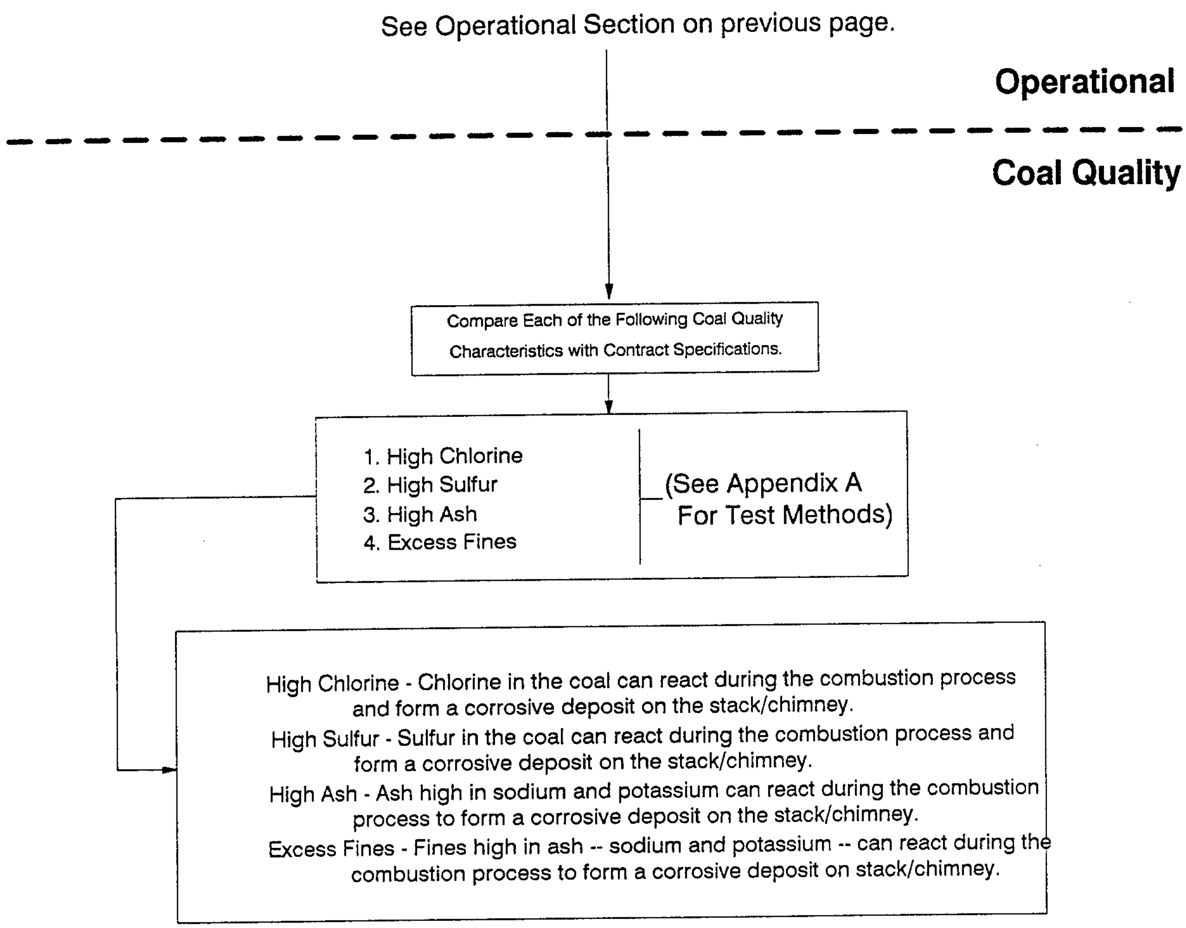
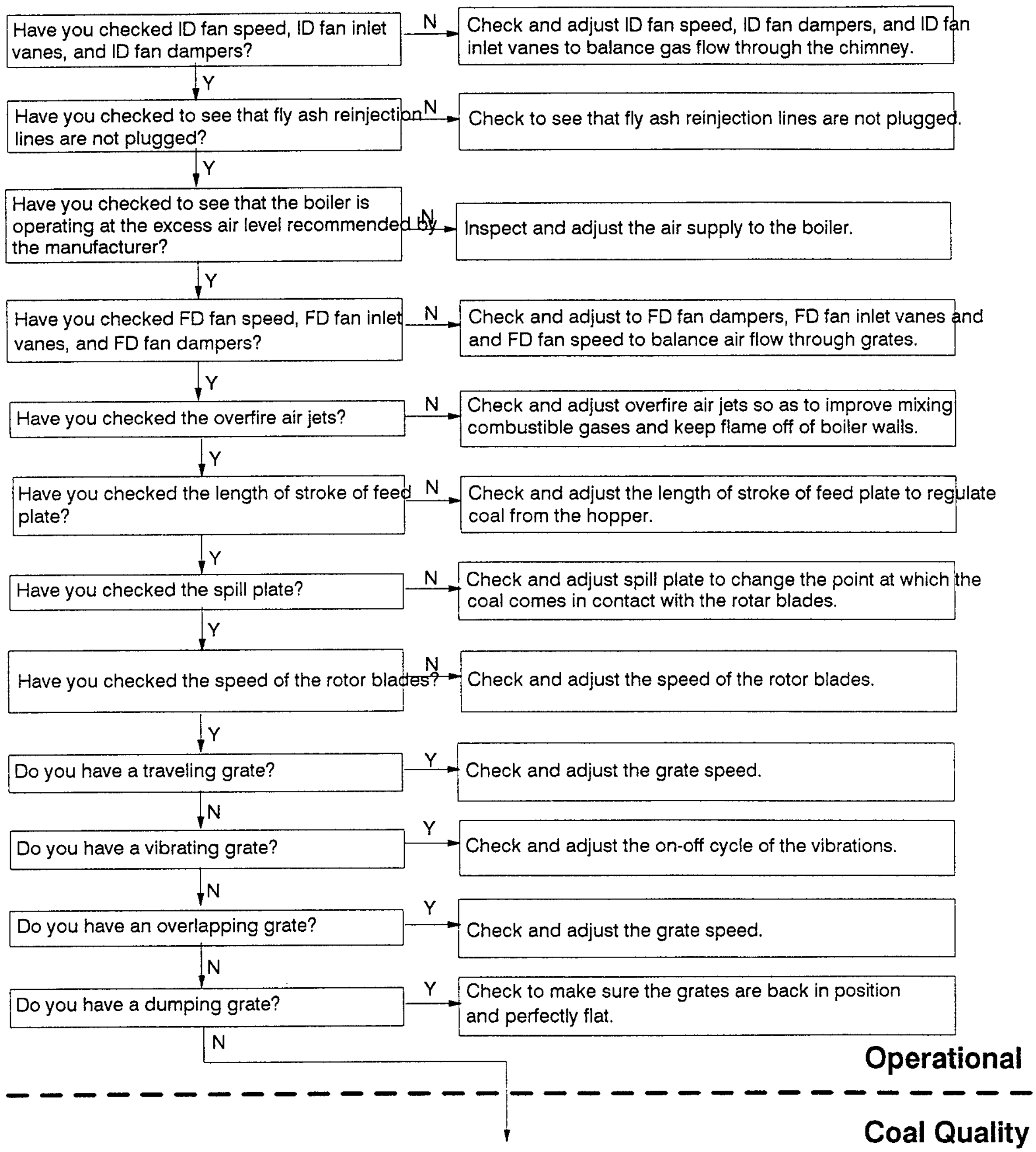


FIG2-94nb/3

FIGURE 2-95: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Stack/Chimney



See next page for Coal Quality Section.

FIG2-95n/4

FIGURE 2-95 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout Of The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

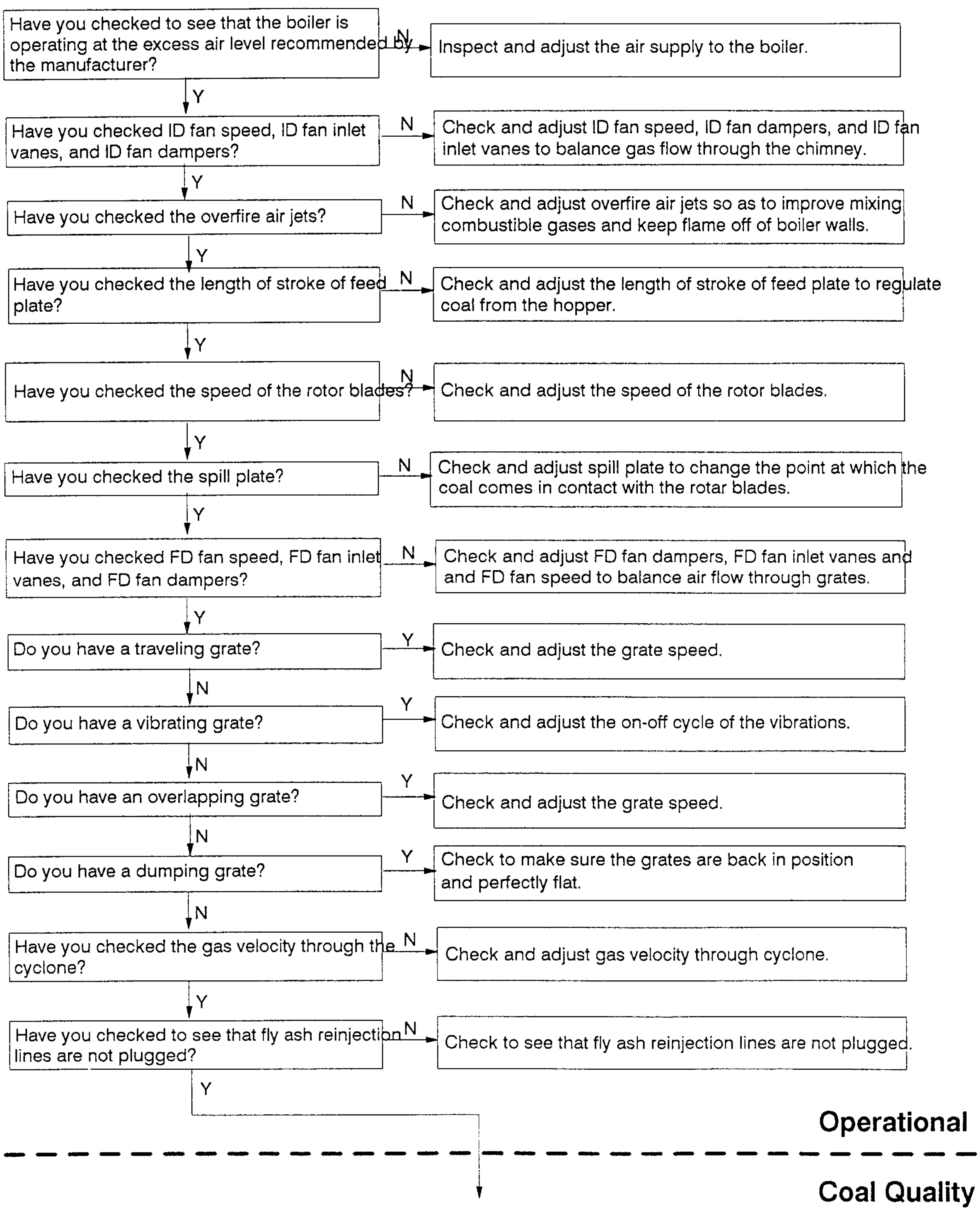
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG2-95nb/3

FIGURE 2-96: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From The Stack/Chimney



See next page for Coal Quality Section.

FIG2-96n/3

FIGURE 2-96 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

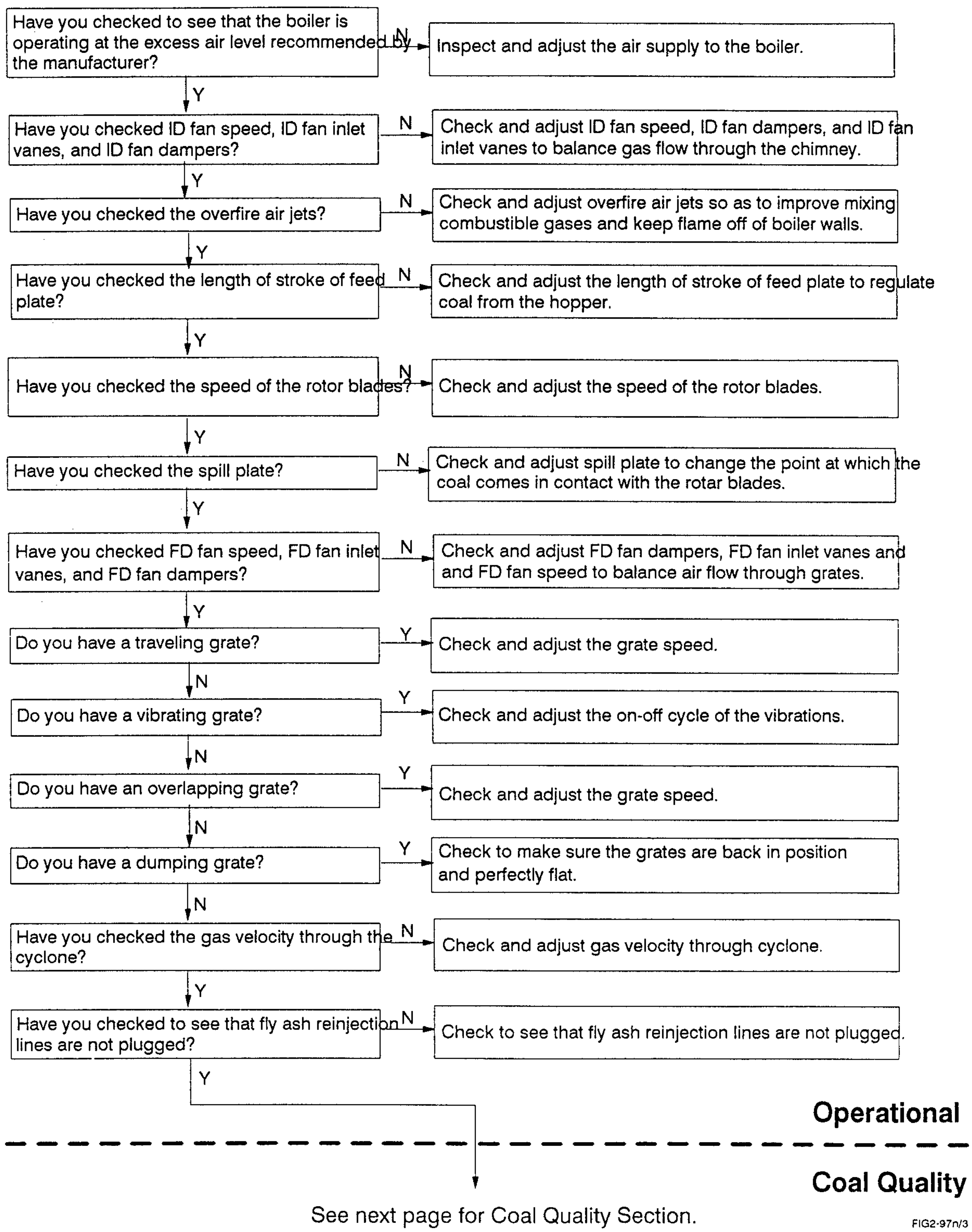
High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG2-96nb/3

FIGURE 2-97: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIGURE 2-97 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

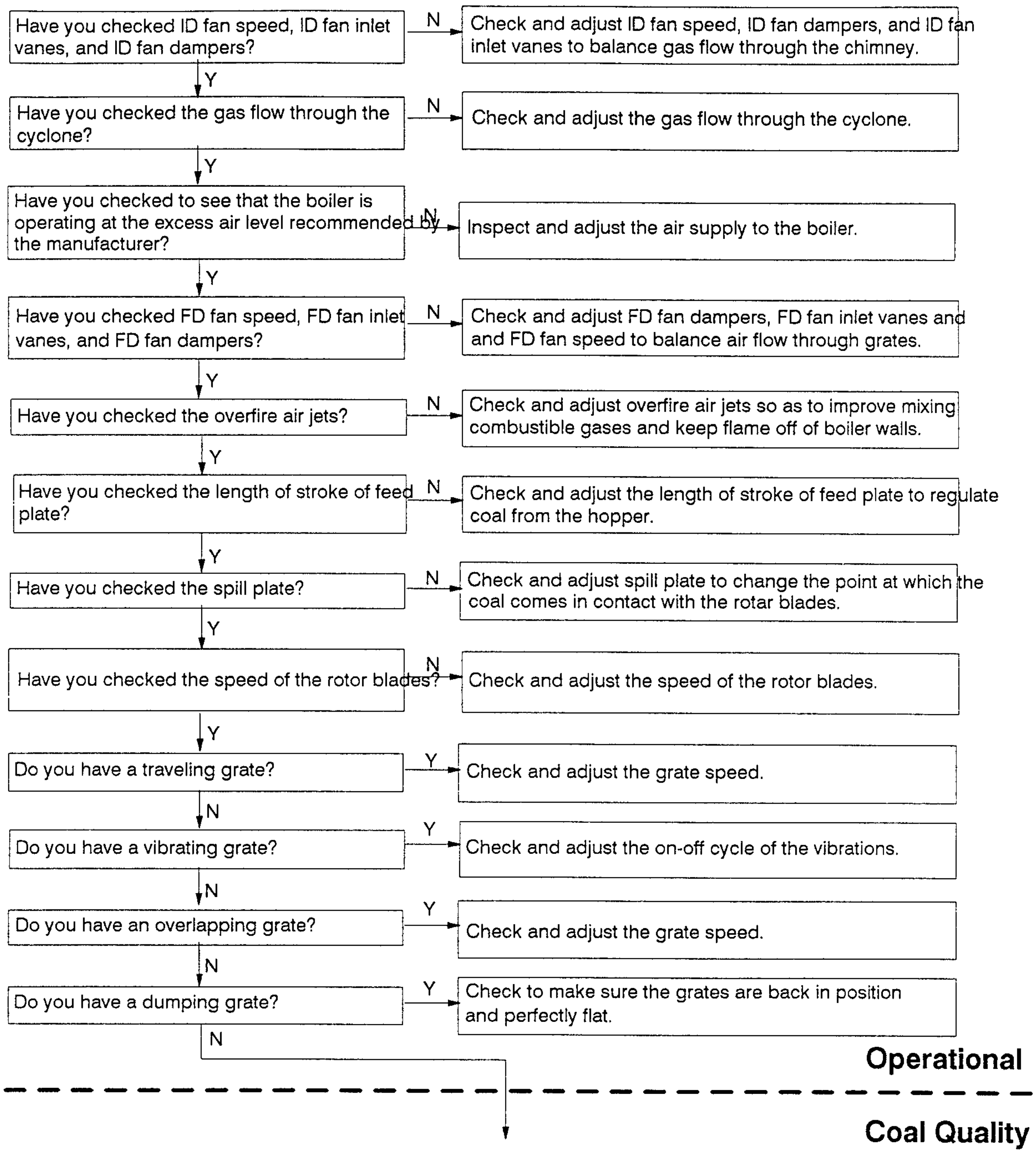
Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG2-97nb/3

FIGURE 2-98: SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For SO_2 Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIG2-98n/4

FIGURE 2-98 (continued): SPREADER STOKER TROUBLESHOOTING LOGIC DIAGRAM For SO_2 Emissions From The Stack/Chimney

See Operational Section on previous page.

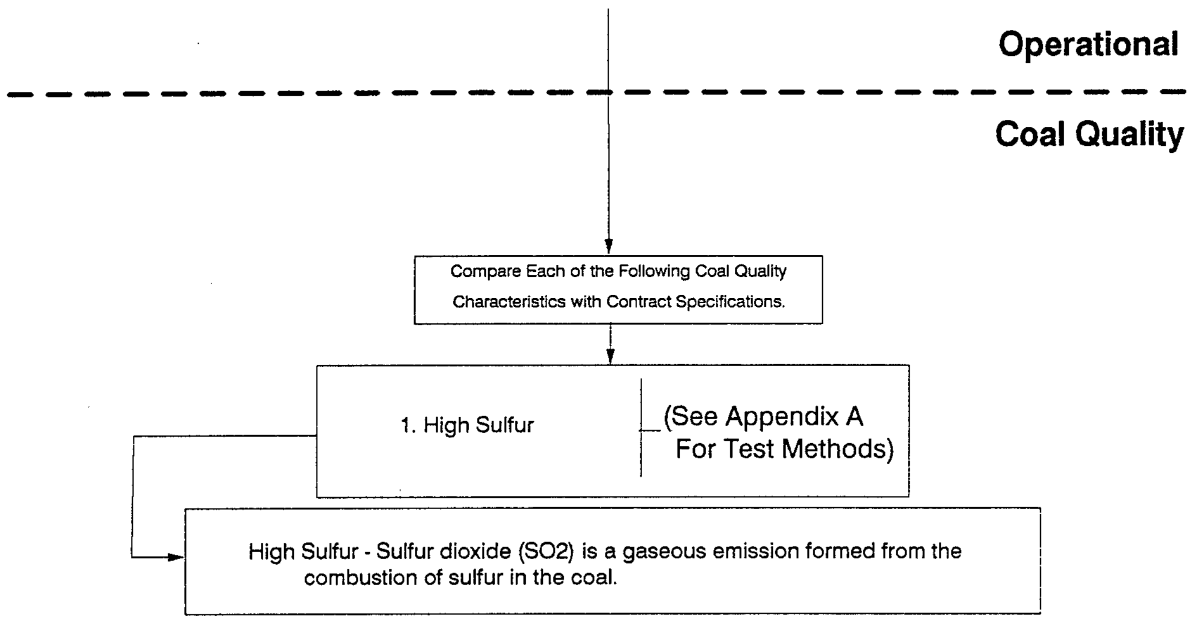


FIG2-98nb/3

Appendix C: Underfeed Stoker-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality-related problems that can be encountered in underfeed stoker-fired boiler systems. A general description of this system is included, but is limited to describing the major components (coal hopper, feeder distributor mechanism, coal-ash bed grates, damper controls) that make up a complete underfeed stoker-fired boiler system. For those interested, more detailed descriptions are provided in references 6, 7, and 8.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

C1 System Description

The different types of underfeed stokers in use today all use the same principle of operation. Coal, fed into a hopper free flows down to a screw (Figure 3-1) or a mechanical ram (Figure 3-2) that forces the coal into a retort chamber. Small- and medium-sized boilers are equipped with single or double retort stokers. The feed ram or screw forces the coal from the hopper into the retort. During normal operation, the retort contains fresh coal that is continuously pushed out over the air-admitting grates by the secondary ram or pusher plates (blocks). The heat absorbed from the coal bed above and the action of the air being admitted through the grates cause the volatile gases to be distilled off and burn as they (the volatiles) pass through the coal bed.

The burning coal slowly moves from the retort toward the sides of the stoker over the grates. As the coal moves down the grates, the flame becomes short since the volatile gases have been consumed and only coke remains. Some coke finds its way to dump grates, and a damper admits air under the grates to further complete combustion before the ashes are dumped. The secondary ram or pusher plates (blocks) are adjustable so coal flow from the retort onto the grates can be varied to obtain optimum fuel-bed conditions.

Underfeed stokers are equipped with forced draft fans for maintaining sufficient air flow through the bed. The air pressure in the windbox under the stoker can be varied to meet load and coal-bed conditions. Air pressure can also be varied under different sections of the stoker to correct for irregular coal-bed conditions.

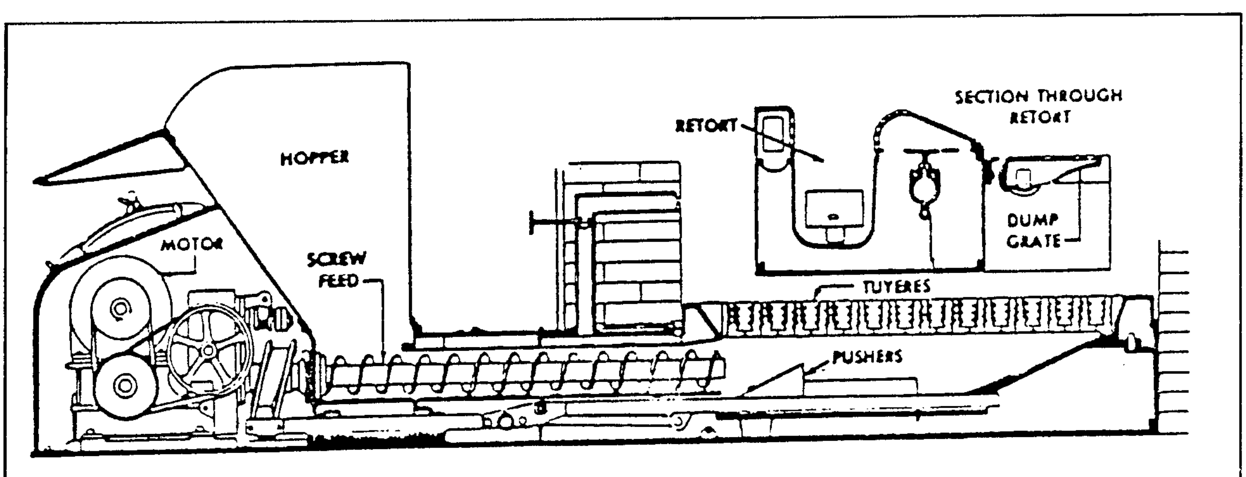


Figure 3-1. Screw-fed single-retort underfeed stoker.

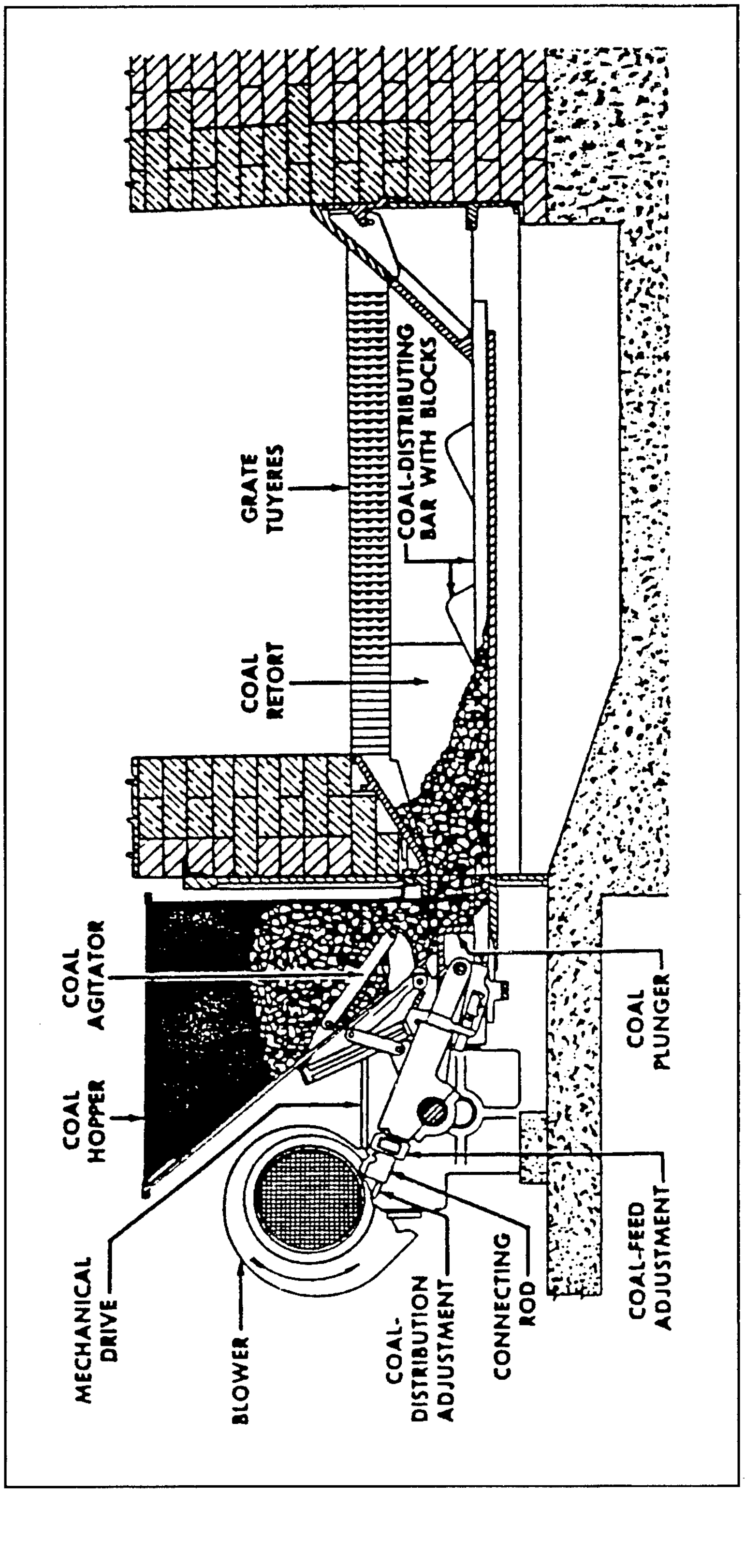


Figure 3-2. Single retort underfeed stoker.

Multiple-retort stokers (Figure 3-3) operate basically the same as single- or double-retort stokers. They are used under large boilers to obtain high combustion rates, and can have up to twelve retorts and grate sections arranged side-by-side to make the required stoker width. A ram feeder supplies each retort with coal. These stokers are inclined at 25 to 30 degrees from the rams toward the ash-discharge end. They are also equipped with secondary rams or pusher plates (blocks) that, together with the effects of gravity produced by inclining the stoker, cause the coal to move toward the rear or refuse discharge. Large multiple-retort stokers have mechanical devices for discharging refuse from the furnace. Dumping grates receive refuse as it comes from extension grates. When a sufficient amount has been collected, the grates are lowered and the refuse is dumped into the ash pit.

Rotary ash discharge may also be used to regulate the rate of refuse discharged from multiple-retort underfeed stokers. Stokers using this type of ash discharge are referred to as clinker grinders. They consist of two rollers with protruding lugs installed in place of dumping grates. These rollers are operated at a variable speed to discharge refuse continuously.

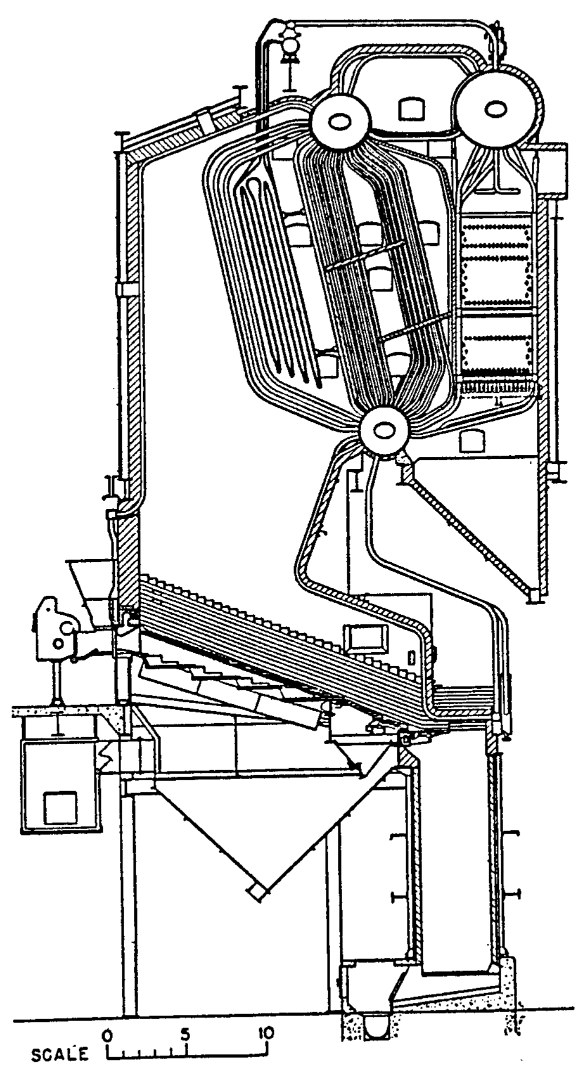


Figure 3-3. Multiple retort stoker boiler.

C2 Block Flow Diagram

The underfeed stoker-fired boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality) sequentially arranged to show:

- coal flow through the coal handling equipment

- flue gas flow through the boiler/components, flyash recycle, and the induced draft fan and chimney/stack
- ash discharge to the ash hopper/pit.

These specific components are identified in Figure 3-4. The first six components have been grouped collectively under a category entitled coal-handling equipment. The coal-handling equipment includes all components that process the coal from its delivery on site to the coal regulating gate. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders, and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- coal feeders that transport coal to the stoker coal hopper
- ram or screw feeder that forces coal into the retort chamber.

The next four components have been loosely grouped under the category entitled Boiler/components. Again, it includes equipment that depending on plant design may include:

- forced draft fan
- grates—specifically stationery and dumping grates
- refractory surfaces
- heat transfer surfaces (boiler tubes, water walls and baffle).

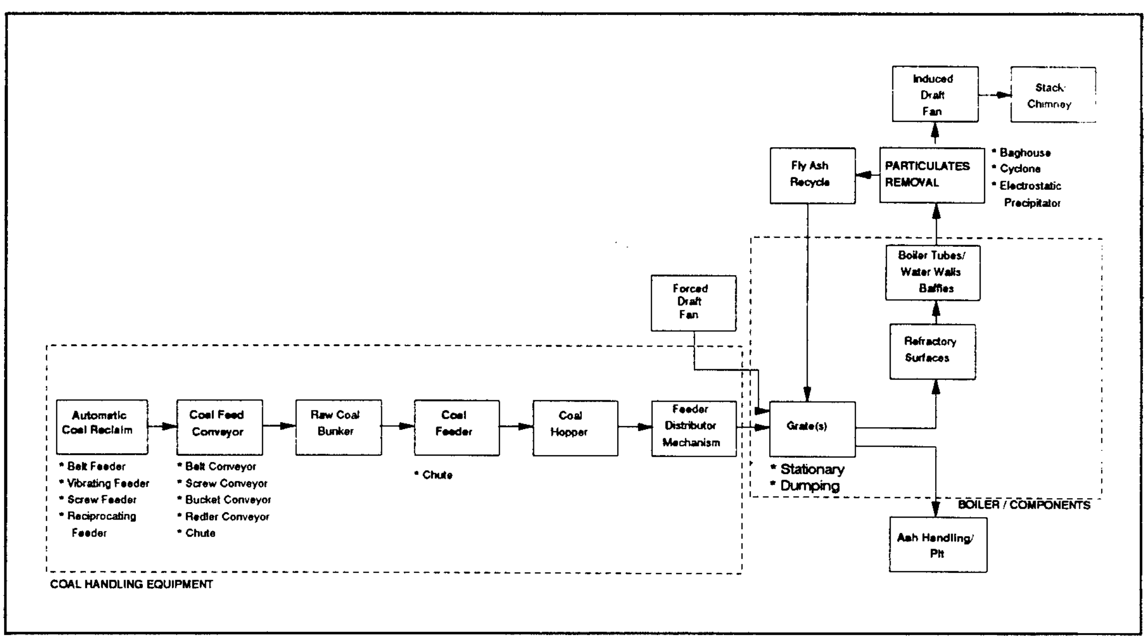


Figure 3-4. Underfeed stoker-fired boiler system components block flow diagram.

The next two blocks represent the flyash recycle and the particulate removal subsystem. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. Underfeed stoker-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the Guide include:

- forced draft (FD) fans, which supply undergrate air
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the Guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/ pit.

C3 Troubleshooting Logic

The component/symptom Guide table (Figure 3-5) serves to identify:

- Typical symptoms (problems) that may be encountered in underfeed stoker--fired boiler systems. These symptoms are arranged horizontally along the top of the table
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram.
- The logic diagrams.

The remainder of this Appendix consists of 92 logic diagrams, arranged by component and by all the symptoms that can affect that component.

FIGURE 3-5 (Part 1): UNDERFEED STOKER - COMPONENT/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																				
Automatic Coal Reclaim																				
1) Belt Feeder	• 3-6	• 3-7	• 3-8	• 3-9																
2) Vibrating Feeder	• 3-10	• 3-11	• 3-12	• 3-13																
3) Screw Feeder	• 3-14	• 3-15	• 3-16	• 3-17																
4) Reciprocating Feeder	• 3-18	• 3-19	• 3-20	• 3-21																
Coal Feed Conveyor																				
1) Belt Conveyor	• 3-22	• 3-23	• 3-24	• 3-25																
2) Screw Conveyor	• 3-26	• 3-27	• 3-28	• 3-29																
3) Bucket Conveyor	• 3-30	• 3-31	• 3-32	• 3-33																
4) Redler Conveyor	• 3-34	• 3-35	• 3-36	• 3-37																
5) Chute		• 3-38	• 3-39	• 3-40																

Figure 3-5. Underfeed stoker—component symptom guide (part 1).

FIGURE 3-5 (Part 2): UNDERFEED STOKER - COMPONENT/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIP.(CONT																				
Coal Feeders																				
Chute		• 3-41	• 3-42	• 3-43																
Coal Bunker		• 3-44	• 3-45	• 3-46																
Coal Hopper		• 3-47	• 3-48	• 3-49																
Feeder Distributor Mechanism	• 3-50	• 3-51	• 3-52	• 3-53																
BOILER / COMPONENTS																				
Boiler			• 3-54											• 3-55						
1) Grates (Stationary / Dumping)					• 3-56	• 3-57	• 3-58	• 3-59	• 3-60	• 3-61	• 3-62	• 3-63	• 3-64							
2) Refractory Surfaces					• 3-65											• 3-66	• 3-67			
3) Boiler Tubes/Water Walls					• 3-68											• 3-69	• 3-70	• 3-71		
4) Baffles					• 3-72											• 3-73	• 3-74	• 3-75		

Figure 3-5. Underfeed stoker—component symptom guide (part 2).

FIGURE 3-5 (Part 3): UNDERFEED STOKER - COMPONENTS/SYMPTOM GUIDE

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
FANS																				
1) Forced Draft			● 3-76												● 3-77					
2) Induced Draft			● 3-78		● 3-79										● 3-80	● 3-81				
PARTICULATE REMOVAL																				
1) Baghouse													● 3-82						● 3-83	
2) Cyclone													● 3-84			● 3-85			● 3-86	
3) Electrostatic Precipitator													● 3-87			● 3-88			● 3-89	
ASH HANDLING																				
1) Fly Ash Recycle													● 3-90							
2) Ash Hopper/Pit												● 3-91	● 3-92							
Stack/Chimney					● 3-93								● 3-94		● 3-95				● 3-96	● 3-97

Figure 3-5. Underfeed stoker—component symptom guide (part 3).

FIGURE 3-6: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Belt Feeder)

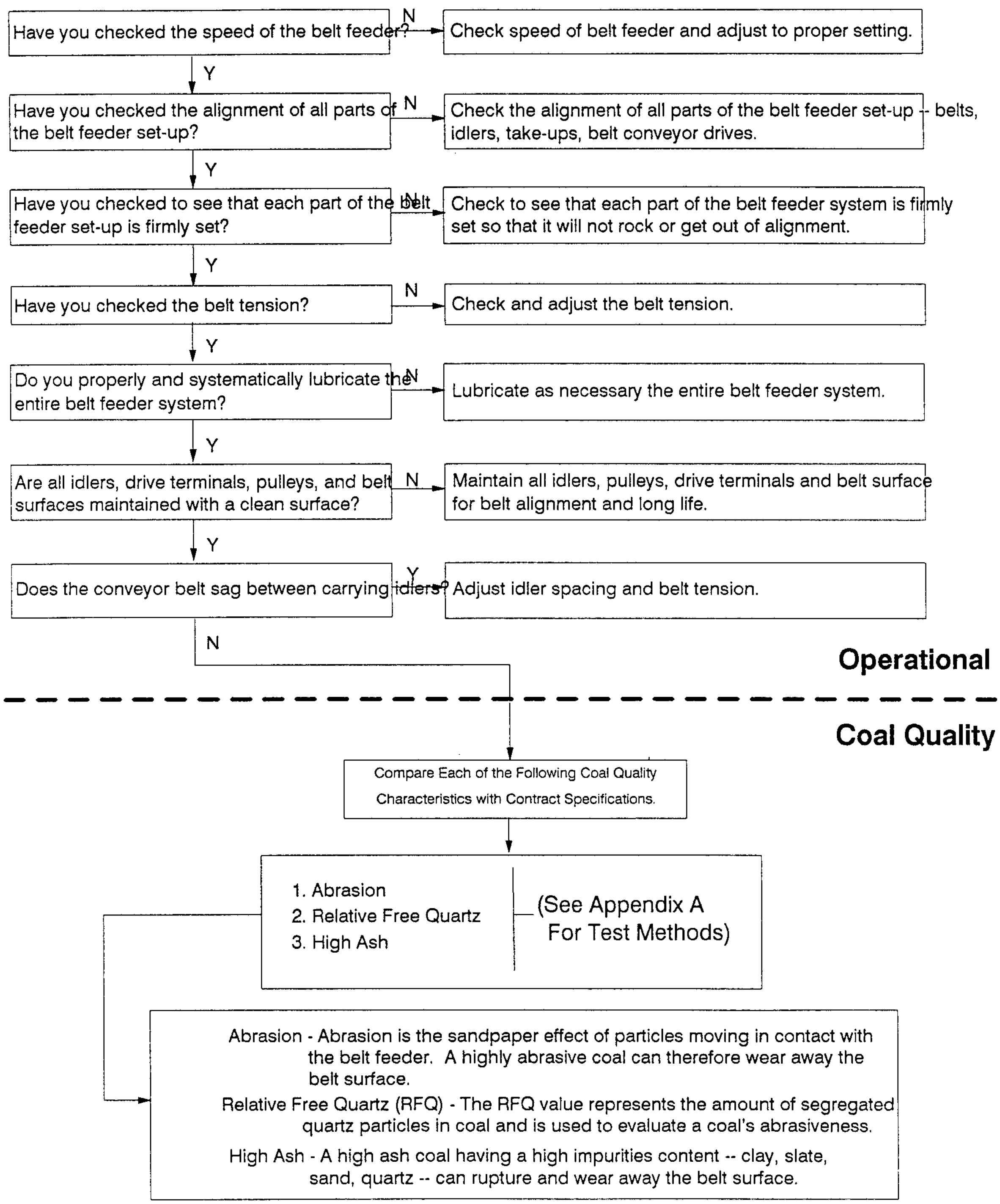


FIG3-6n/1

FIGURE 3-7: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim

(Belt Feeder)

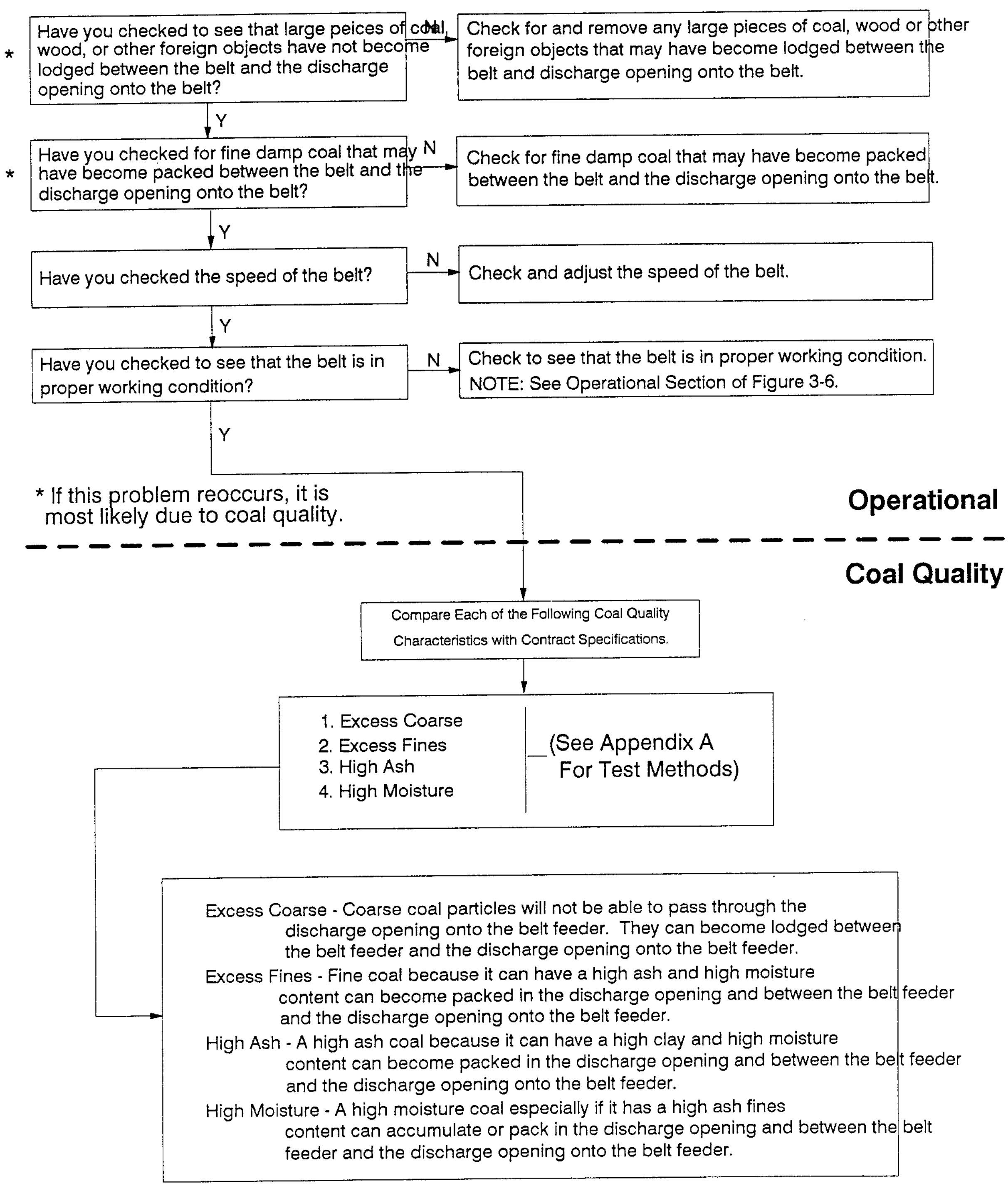


FIG3-7n/1

FIGURE 3-8: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Belt Feeder)

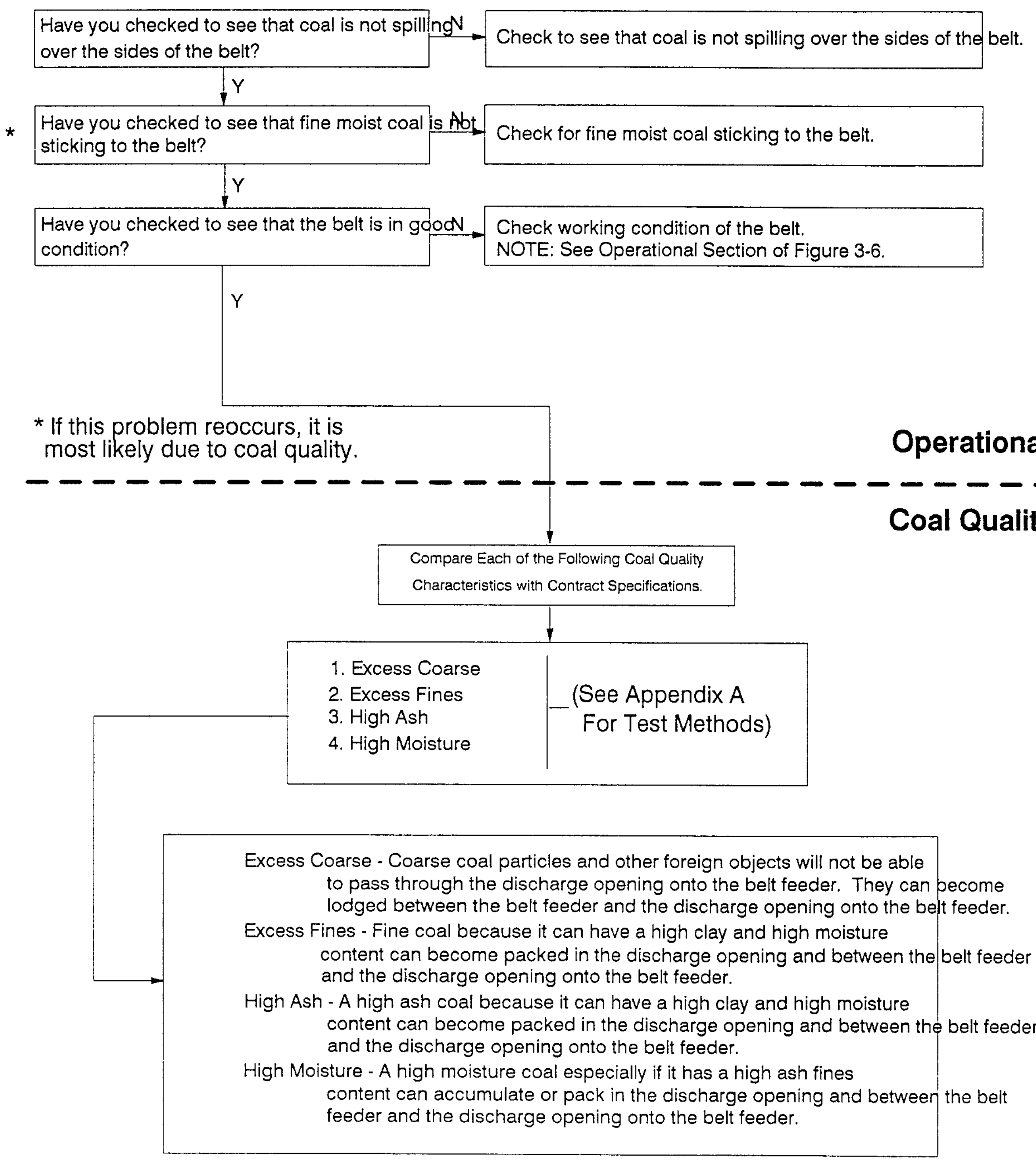


FIG3-8n/1

FIGURE 3-9: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Belt Feeder)

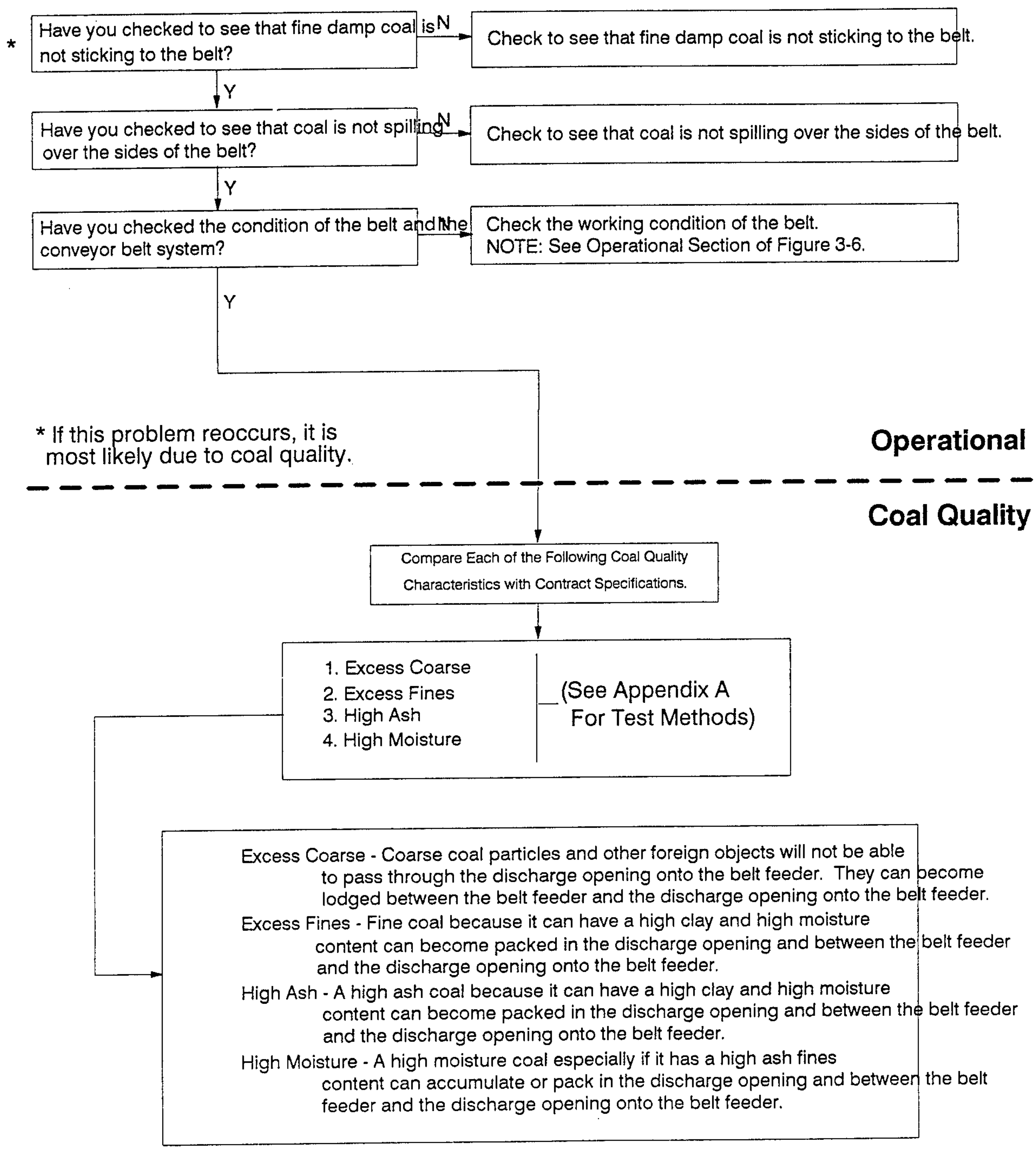


FIG3-9n/1

FIGURE 3-10: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Vibrating Feeder)

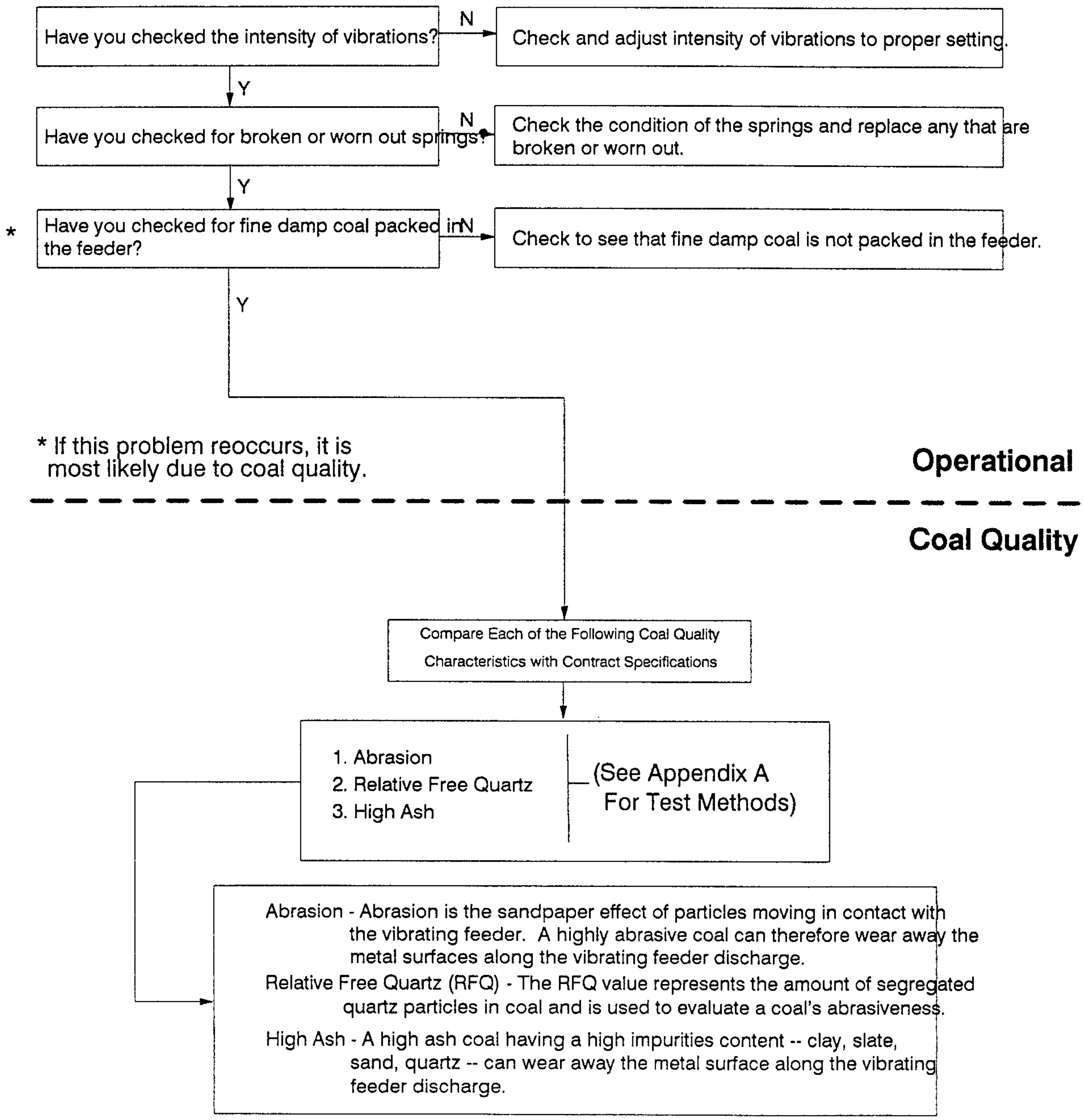


FIG3-10n/1

FIGURE 3-11: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Vibrating Feeder)

Have you checked the intensity of vibrations? — N → Check and adjust the intensity of vibrations to the proper setting.

↓ Y

Have you checked for broken or worn out springs? — N → Check the condition of the springs and replace any that are broken or worn out.

↓ Y

*Have you checked for fine damp coal packed in the feeder? — N → Check for fine damp coal packed in the feeder.

↓ Y

*Have you checked for large rocks, wood or pieces of coal lodged in the feeder? — N → Check for and remove any large pieces of coal, wood, or other foreign objects that have become lodged in the feeder.

↓ Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

↓

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

↓

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the vibrating feeder discharge opening onto the coal feed conveyor. They can become lodged between the vibrating feeder discharge opening and the coal feed conveyor.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

FIG3-11n/1

FIGURE 3-12: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Vibrating Feeder)

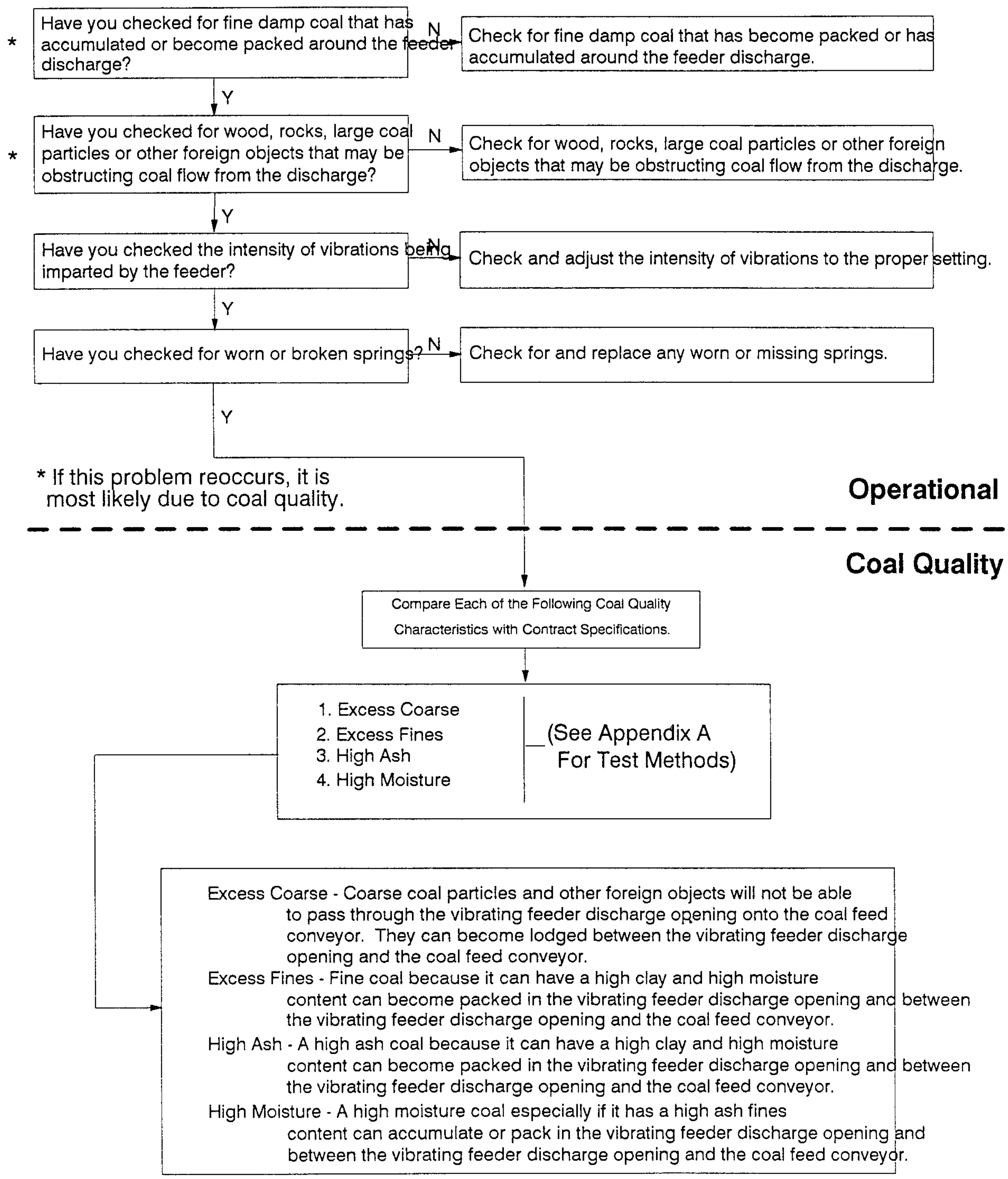


FIG3-12n/1

FIGURE 3-13: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim (Vibrating Feeder)

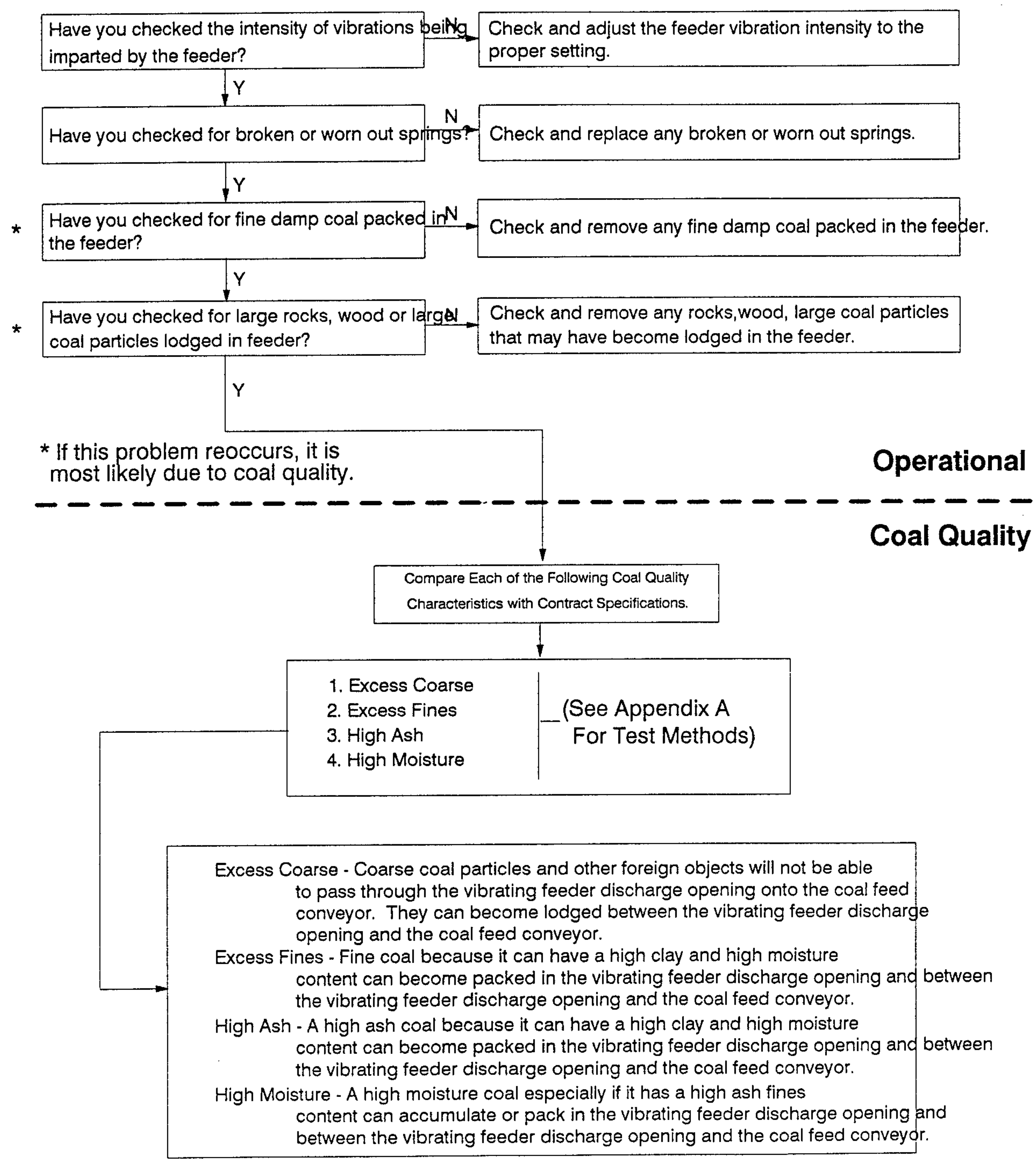


FIG3-13n/1

FIGURE 3-14: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Screw Feeder)

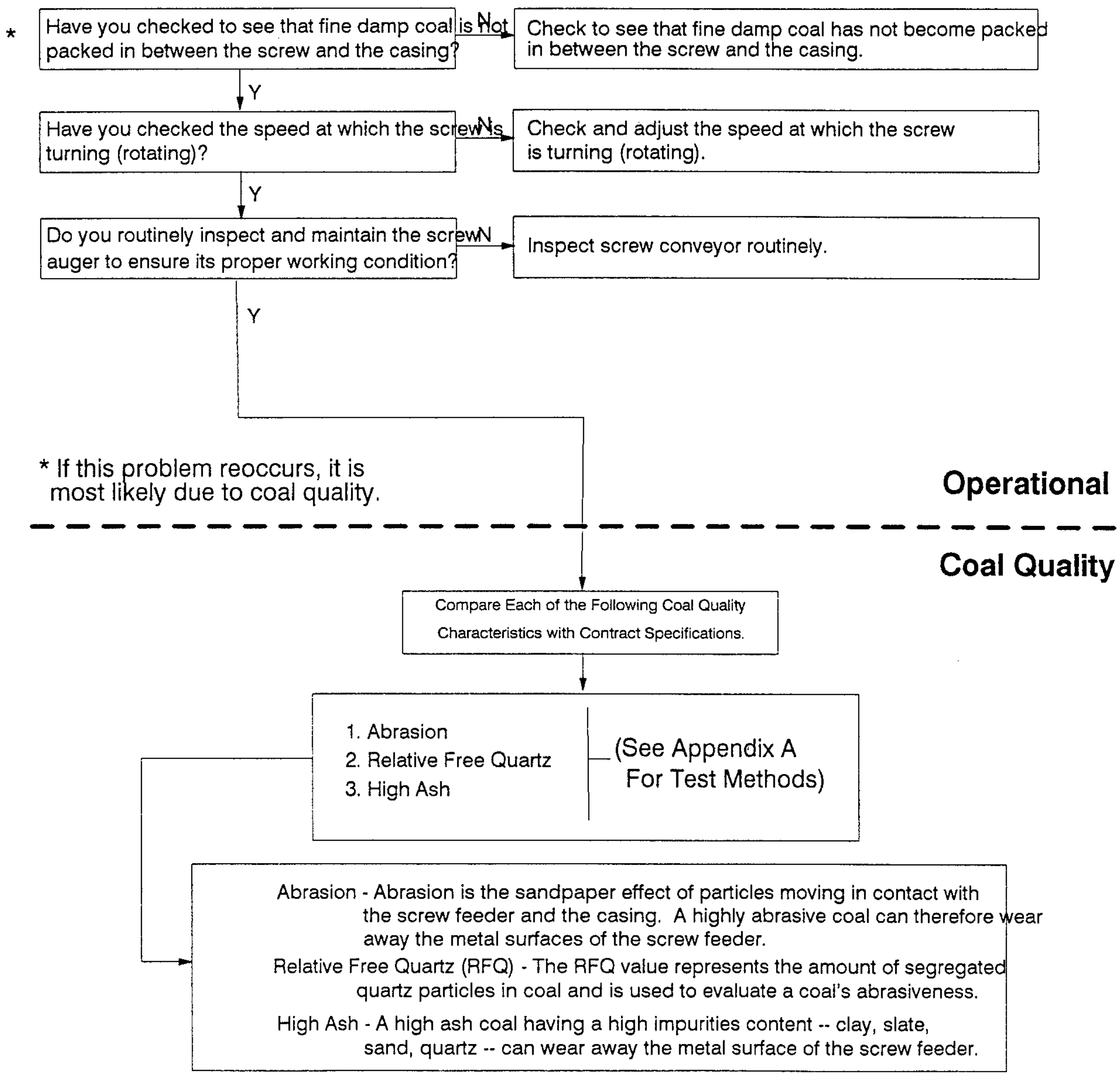


FIG3-14n/1

FIGURE 3-15: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim

(Screw Feeder)

Is the auger turned on? — N → Turn on the auger.

Y

Have you checked the speed of the screw? — N → Check and adjust the speed of the screw.

Y

* Have you checked for large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor? — N → Check for and remove any large rocks, wood, pieces of coal or or other foreign objects preventing coal flow onto the coal feed conveyor.

Y

* Have you checked for frozen coal? — N → Check for and dislodge any frozen coal.

Y

* Have you checked for fine damp coal packed between the screw and the casing? — N → Check for fine damp coal that may be packed between the screw and the casing.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw feeder and the casing surrounding the screw feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw feeder and the casing surrounding the screw feeder.

FIG3-15n/1

FIGURE 3-16: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim (Screw Feeder)

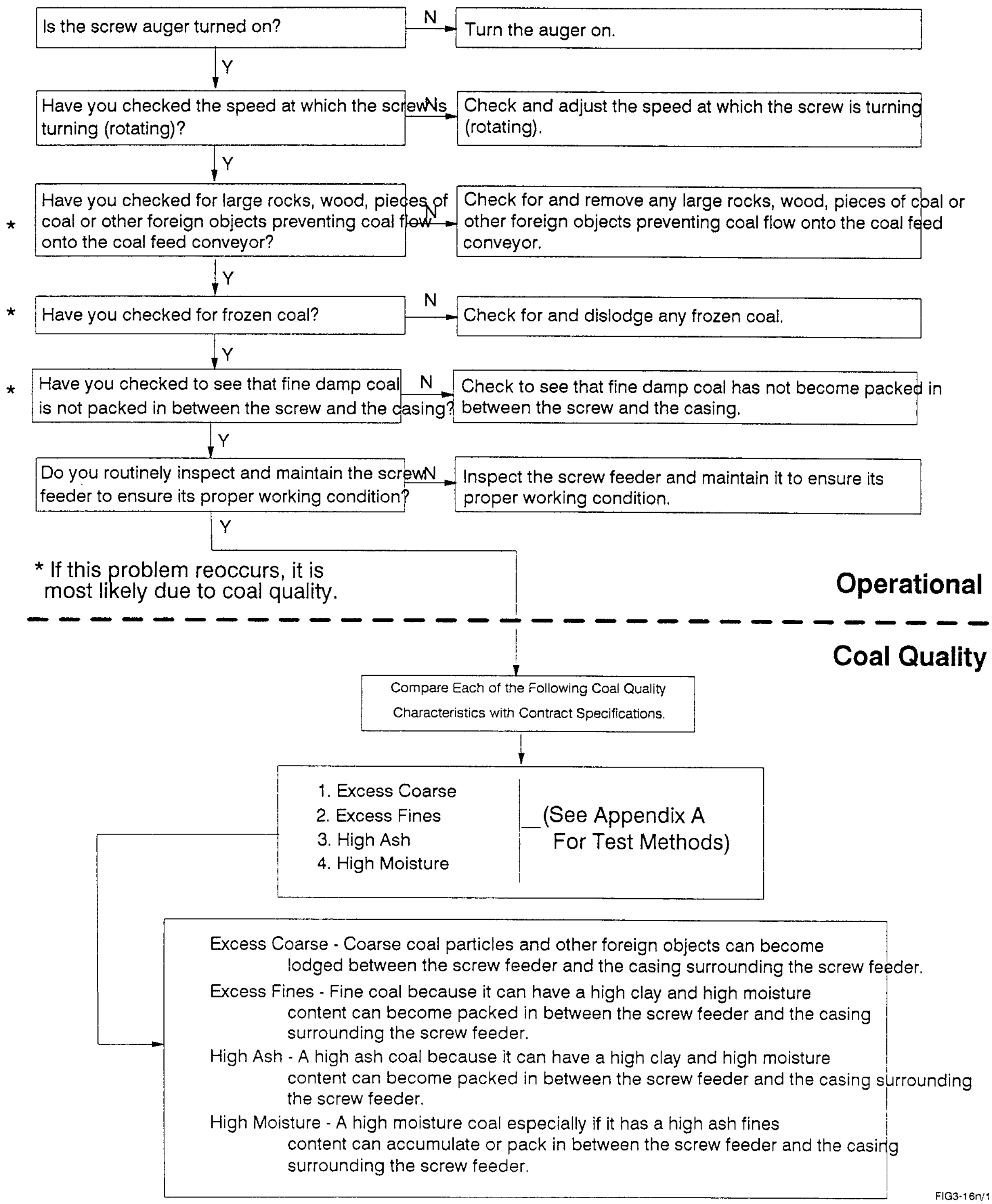


FIGURE 3-17: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feed From The Automatic Coal Reclaim
(Screw Feeder)

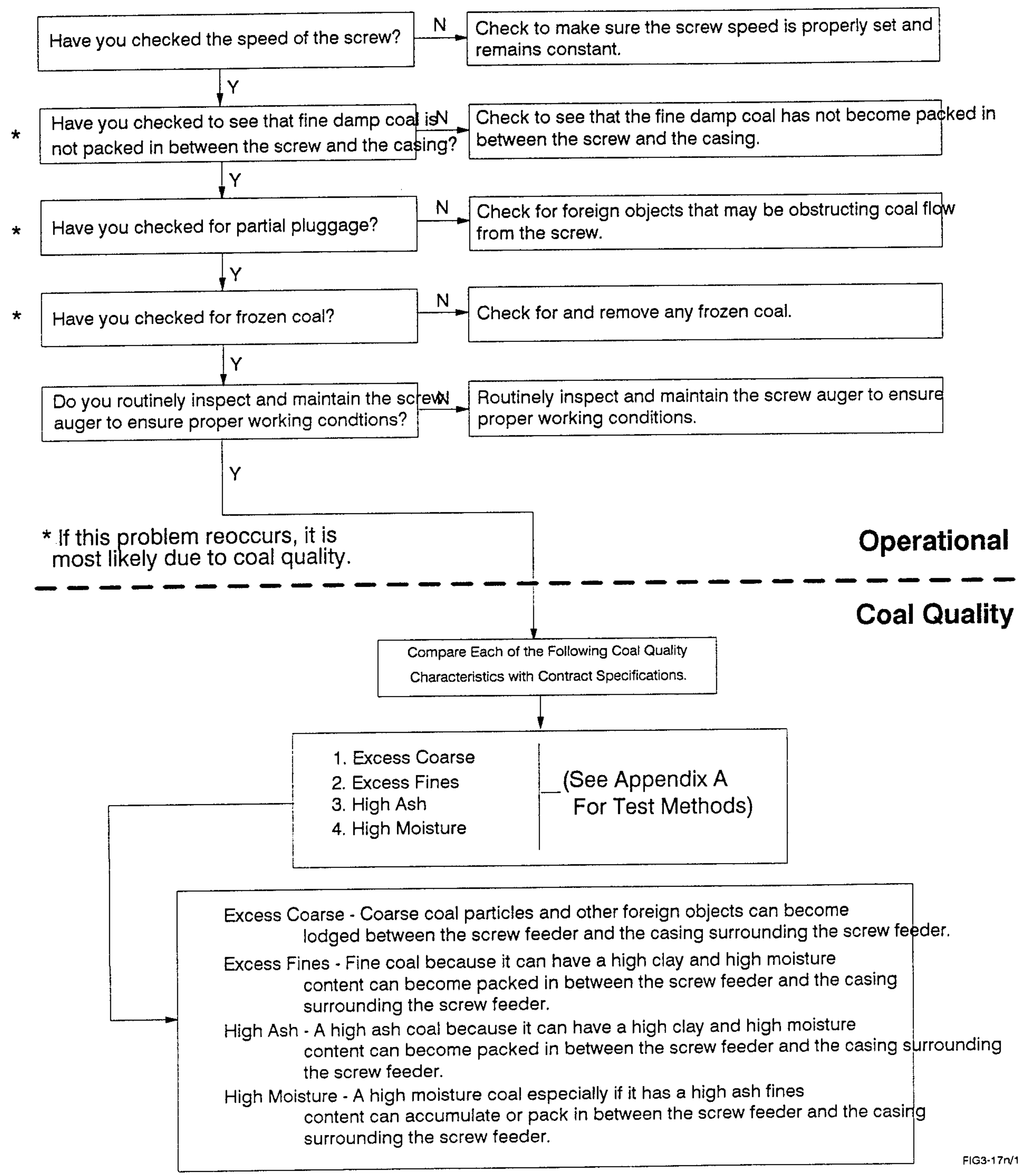


FIGURE 3-18: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Reciprocating Feeder)

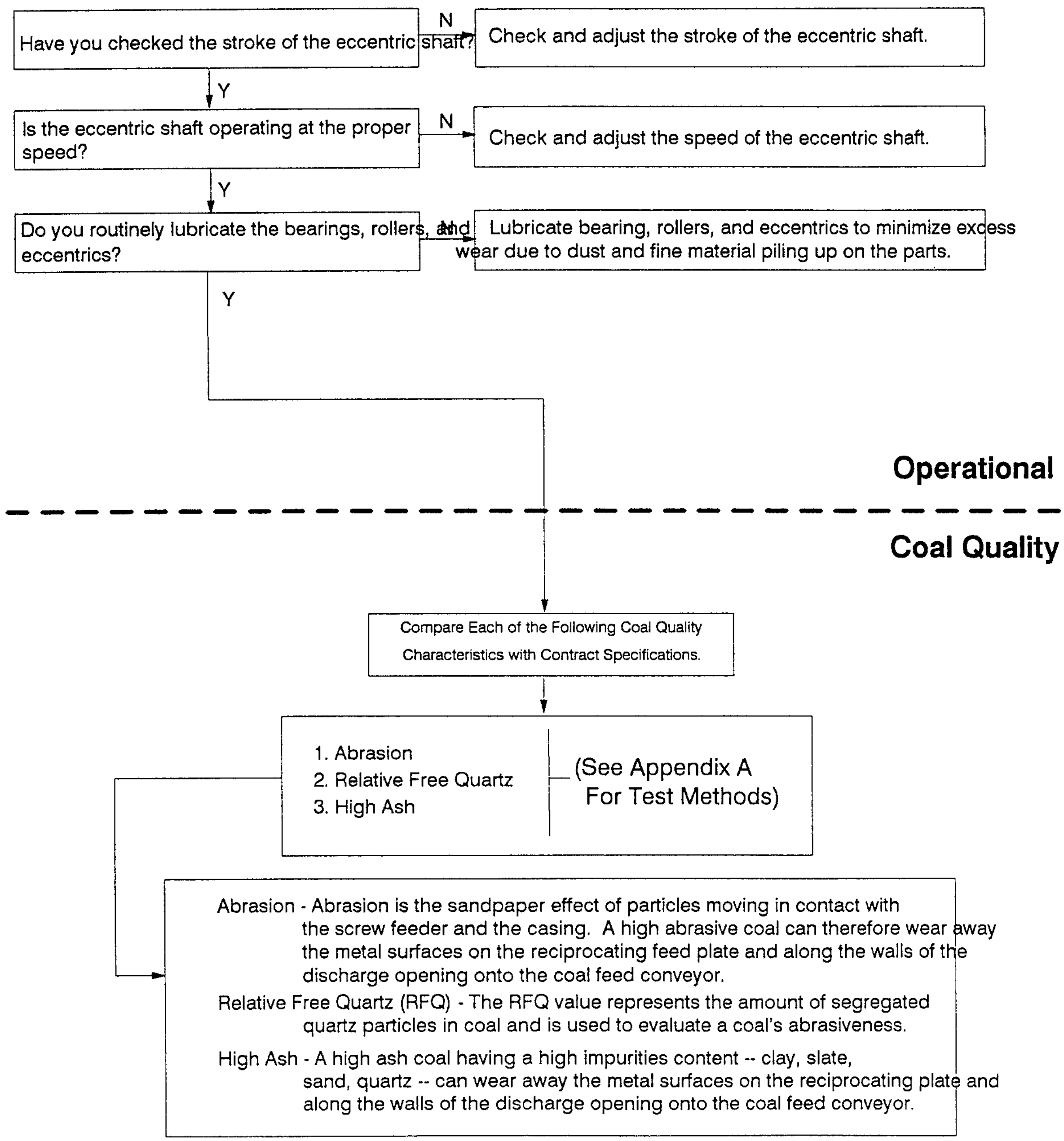


FIG3-18n/1

FIGURE 3-19: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Reciprocating Feeder)

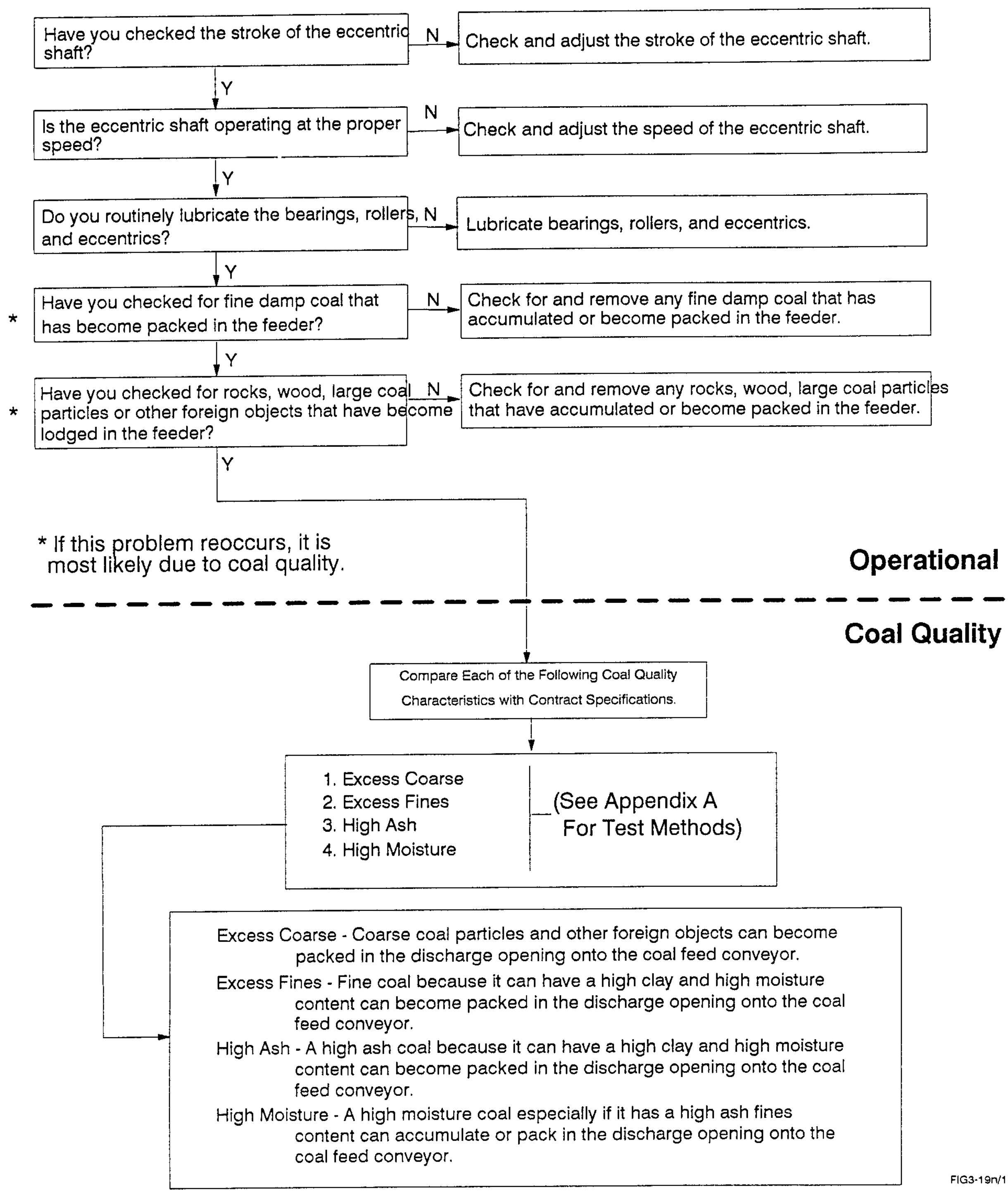


FIG3-19n/1

FIGURE 3-20: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Reciprocating Feeder)

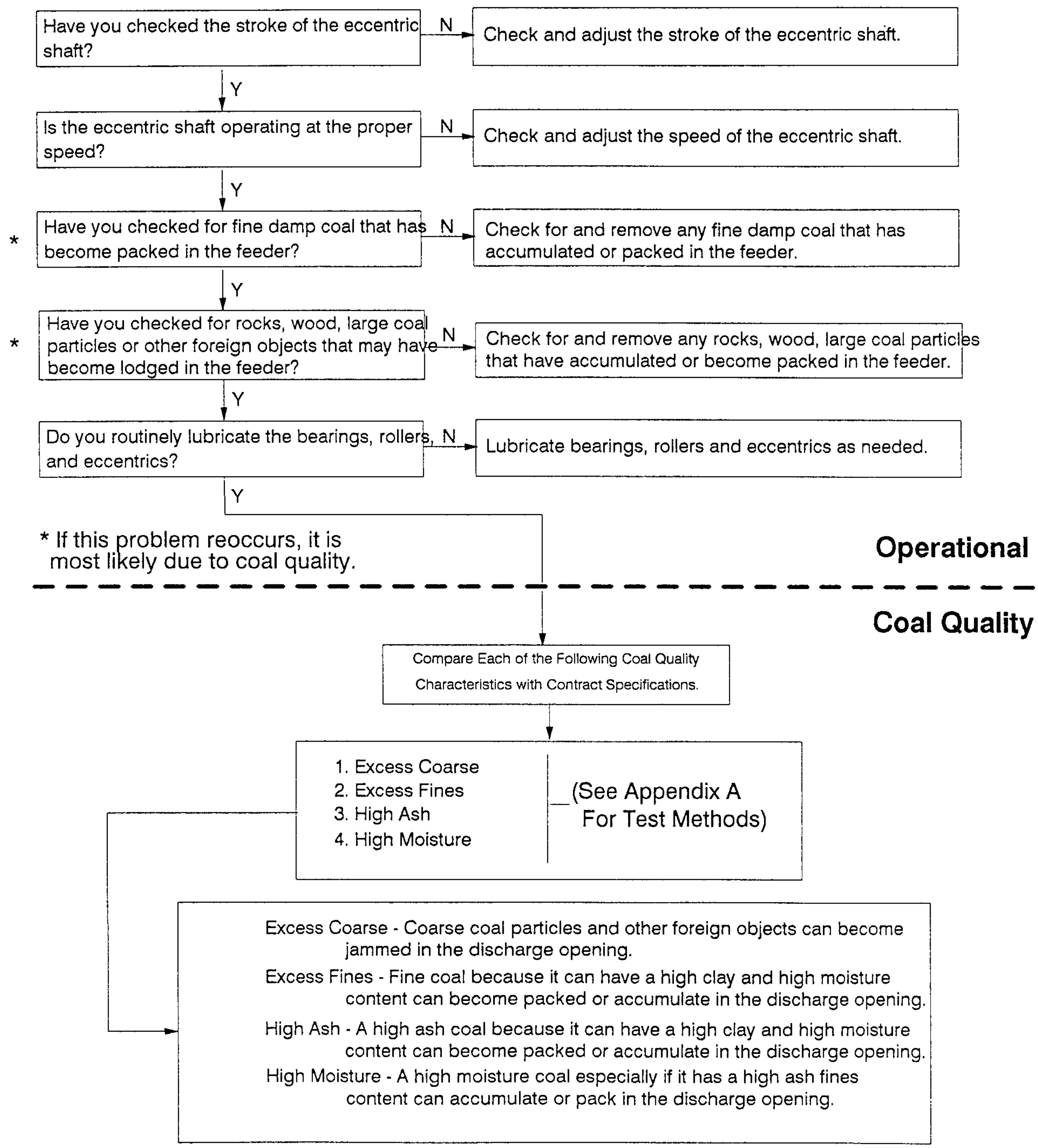


FIG3-20n/1

FIGURE 3-21: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Reciprocating Feeder)

* Have you checked for fine damp coal that has accumulated or become packed in the feeder?
- N → Check for and loosen any fine damp coal that has accumulated or become packed in the feeder.
- Y ↓

* Have you checked for rocks, wood, large coal particles or other foreign object that may be obstructing coal flow?
- N → Remove any foreign objects, rocks, wood, large coal particles that may be obstructing coal flow.
- Y ↓

Have you checked the stroke of the eccentric shaft?
- N → Check and adjust the stroke of the eccentric shaft.
- Y ↓

Is the eccentric shaft operating at the proper speed?
- N → Check and adjust the speed of the eccentric shaft.
- Y ↓

Do you routinely lubricate the bearings, rollers and eccentrics?
- N → Routinely inspect and lubricate bearings, rollers, and eccentrics to minimize excess wear due to dust and fine coal piling upon the parts.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become jammed in the discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed or accumulate in the discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate in the discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening.

FIG3-21n/1

FIGURE 3-22: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Coal Feed Conveyor
(Belt Conveyor)

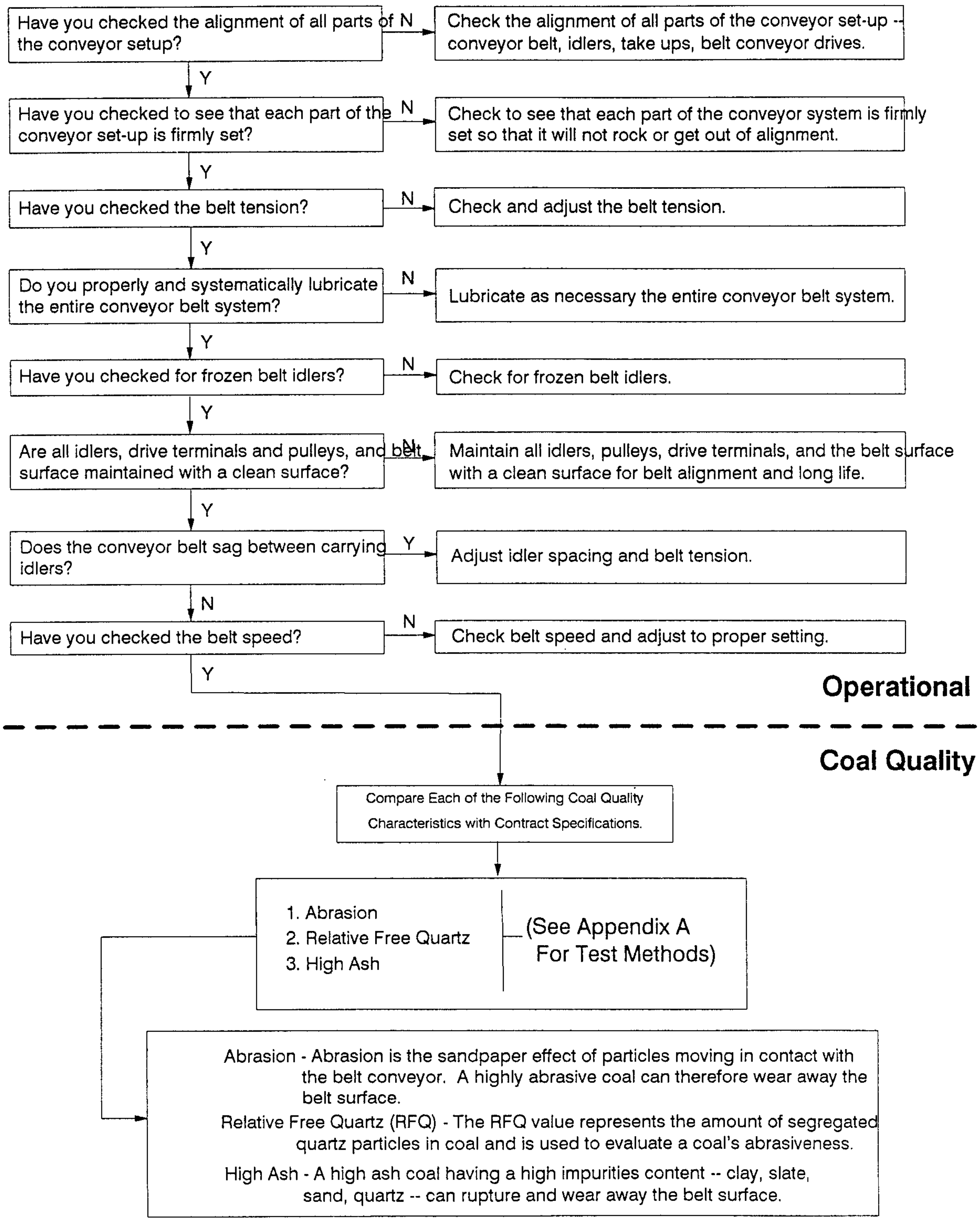


FIG3-22n/1

FIGURE 3-23: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor

(Belt Conveyor)

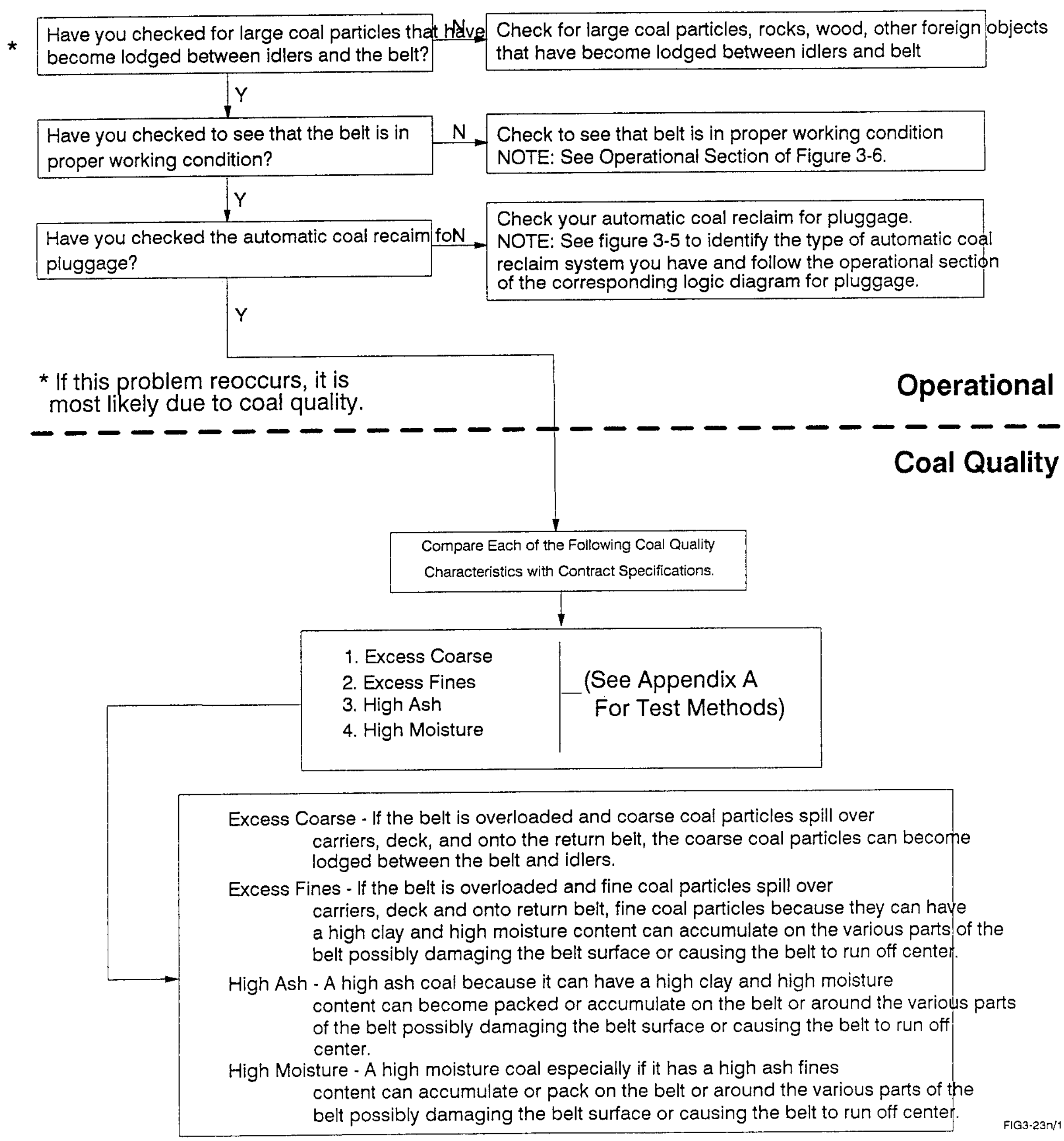


FIGURE 3-24: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Belt Conveyor)

Have you checked to see that coal is not spilling over the sides of the belt? — N → Check for coal spilling over the sides of the belt.

Y

* Have you checked to see that fine moist coal is not sticking to the belt? — N → Check for moist fine coal sticking to the belt.

Y

Have you checked to see that the belt is in good working condition? — N → Checking the working condition of the belt. NOTE: See Operational Section Of Figure 3-6.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - If the belt is overloaded and coarse coal particles spill over carriers, deck, and onto the return belt, the coarse coal particles can become lodged between the belt and idlers.

Excess Fines - If the belt is overloaded and fine coal particles spill over carriers, deck and onto return belt, fine coal particles because they can have a high clay and high moisture content can accumulate on the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

FIG3-24n/1

FIGURE 3-25: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Belt Conveyor)

* Have you checked to see that fine damp coal is not sticking to the belt? — N → Check to see that fine damp coal is not sticking to the belt.

Y ↓

Have you checked to see that coal is not spilling over the sides of the belt? — N → Check to see that coal is not spilling over the sides of the belt.

Y ↓

Have you checked to see that the belt is in proper working condition? — N → Check the working condition of the belt. NOTE: See Operational Section of Figure 3-6.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - If the belt is overloaded and coarse coal particles spill over carriers, deck, and onto the return belt, the coarse coal particles can become lodged between the belt and idlers.

Excess Fines - If the belt is overloaded and fine coal particles spill over carriers, deck and onto return belt, fine coal particles because they can have a high clay and high moisture content can accumulate on the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

FIG3-25n/1

FIGURE 3-26: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM for Excess Wear In The Coal Feed Conveyor (Screw Conveyor)

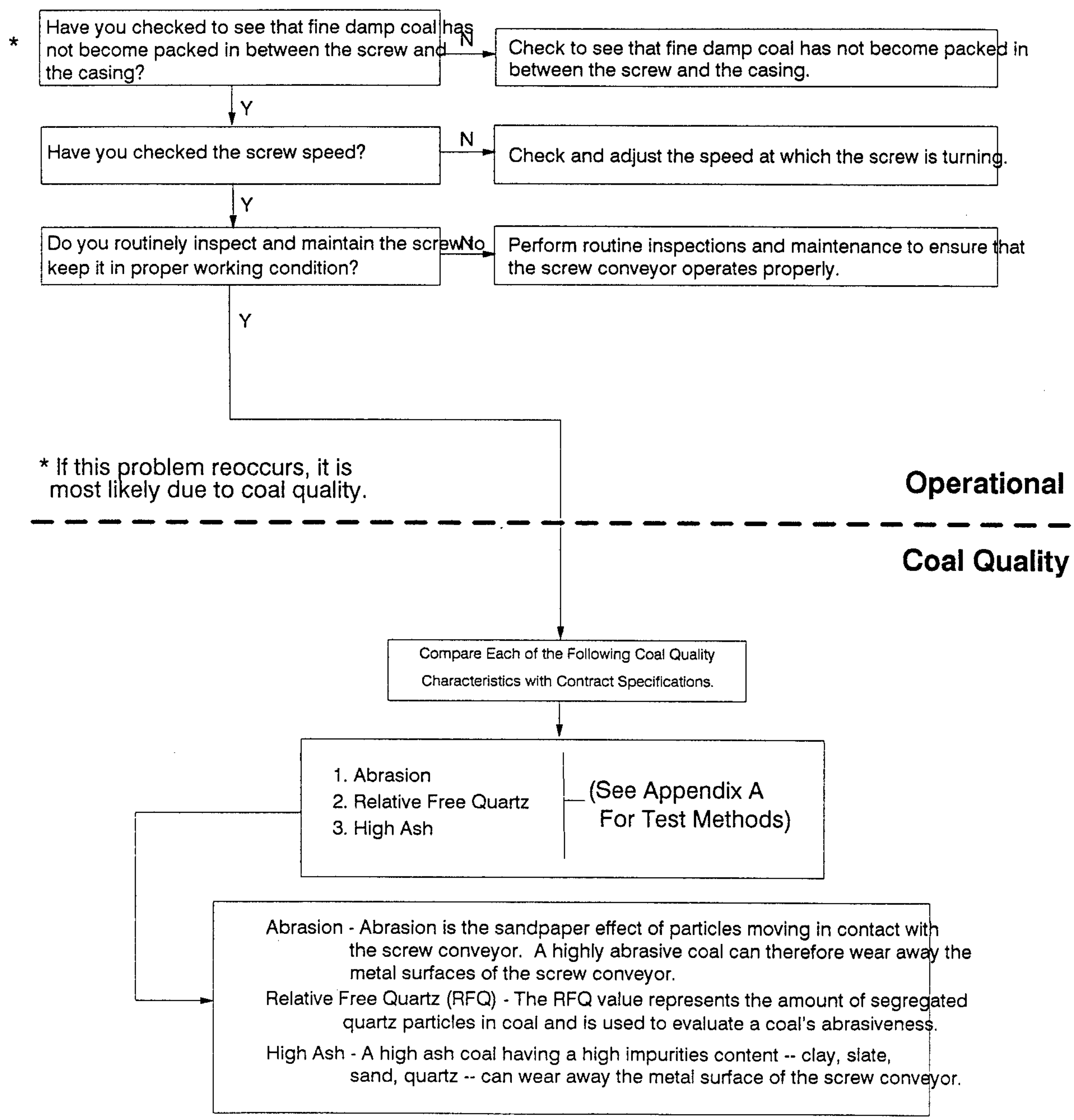


FIG3-26n/1

FIGURE 3-27: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Screw Conveyor)

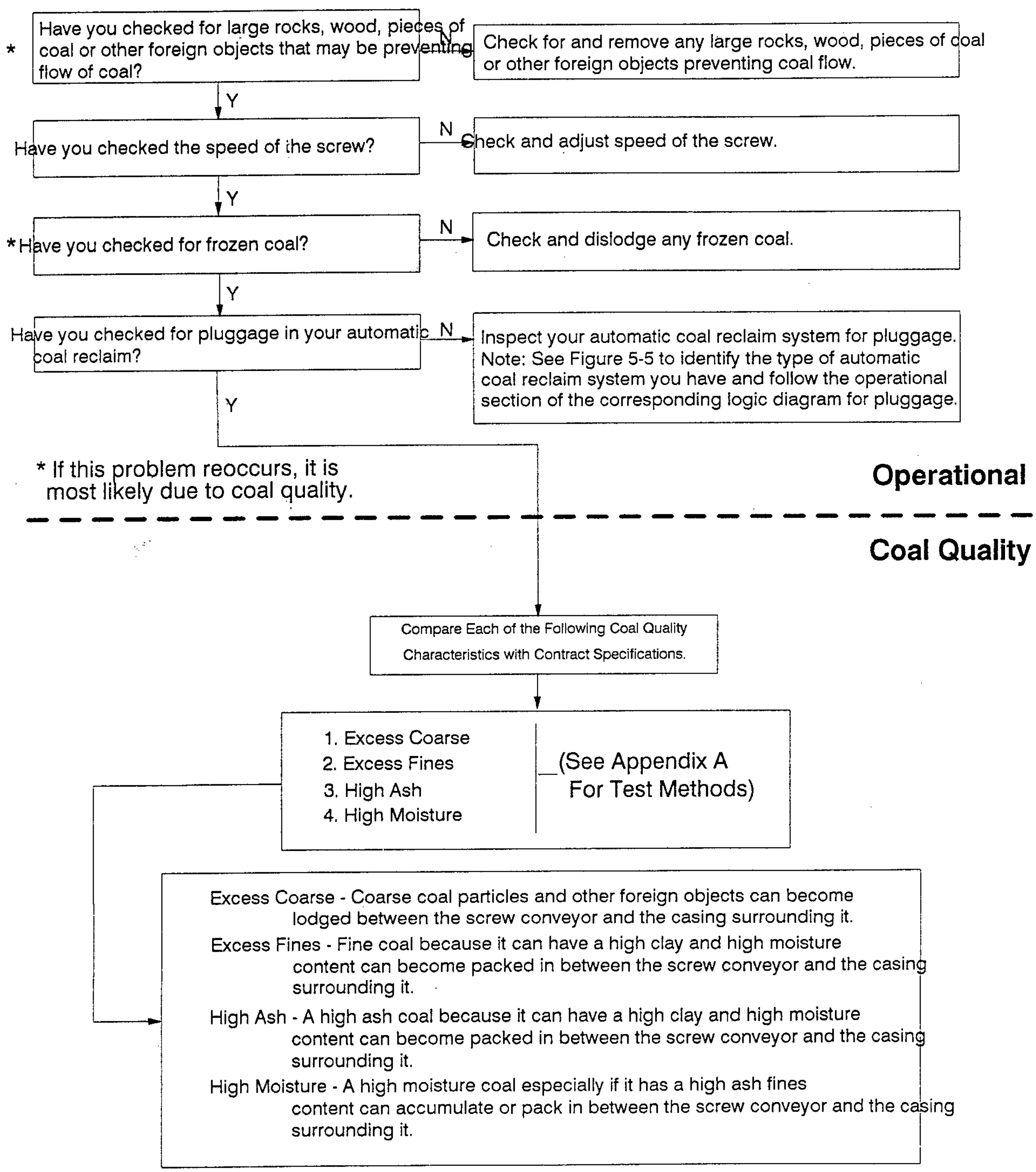


FIG3-27n/1

FIGURE 3-28: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor (Screw Conveyor)

* Have you checked to see that fine damp coal is not packed in between the screw and the casing?
  - N → Check to see that fine damp coal has not become packed in between the screw and the casing.
  - Y ↓

Have you checked the speed at which the screw is operating?
  - N → Check the speed at which the screw is operating and adjust to the proper setting.
  - Y ↓

* Have you checked for frozen coal?
  - N → Check for and dislodge frozen coal.
  - Y ↓

Have you checked the coal feed rate to the screw conveyor?
  - N → Check and adjust coal feed rate from you automatic coal reclaim.
  - Y ↓

Do you routinely inspect and maintain the screw feeder to ensure its proper working condition?
  - N → Perform routine inspections and maintenance to ensure that the screw conveyor operators properly.
  - Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw conveyor and the casing surrounding it.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw conveyor and the casing surrounding it.

FIG3-28n/1

FIGURE 3-29: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor
(Screw Conveyor)

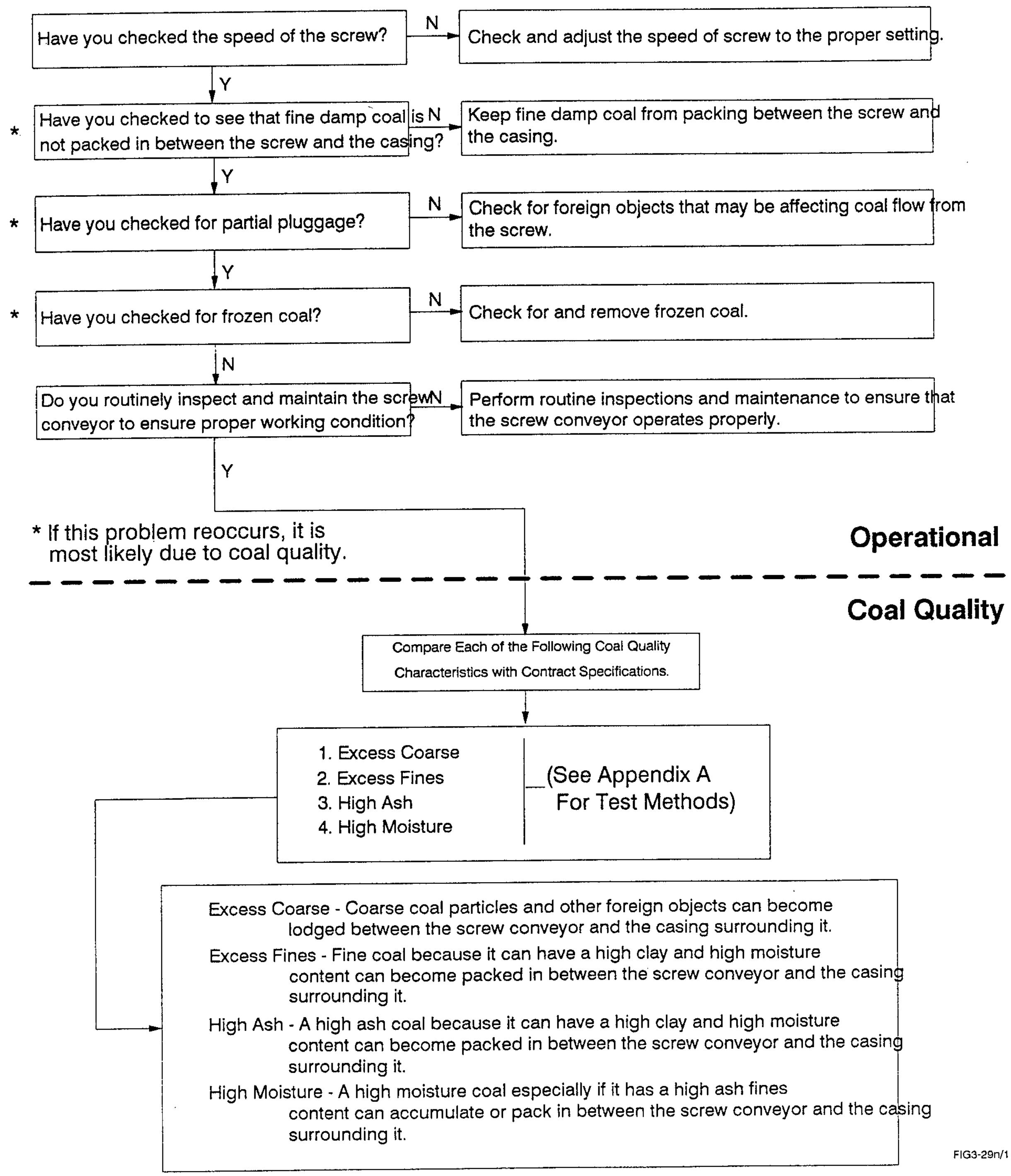


FIGURE 3-30: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor (Bucket Conveyor)

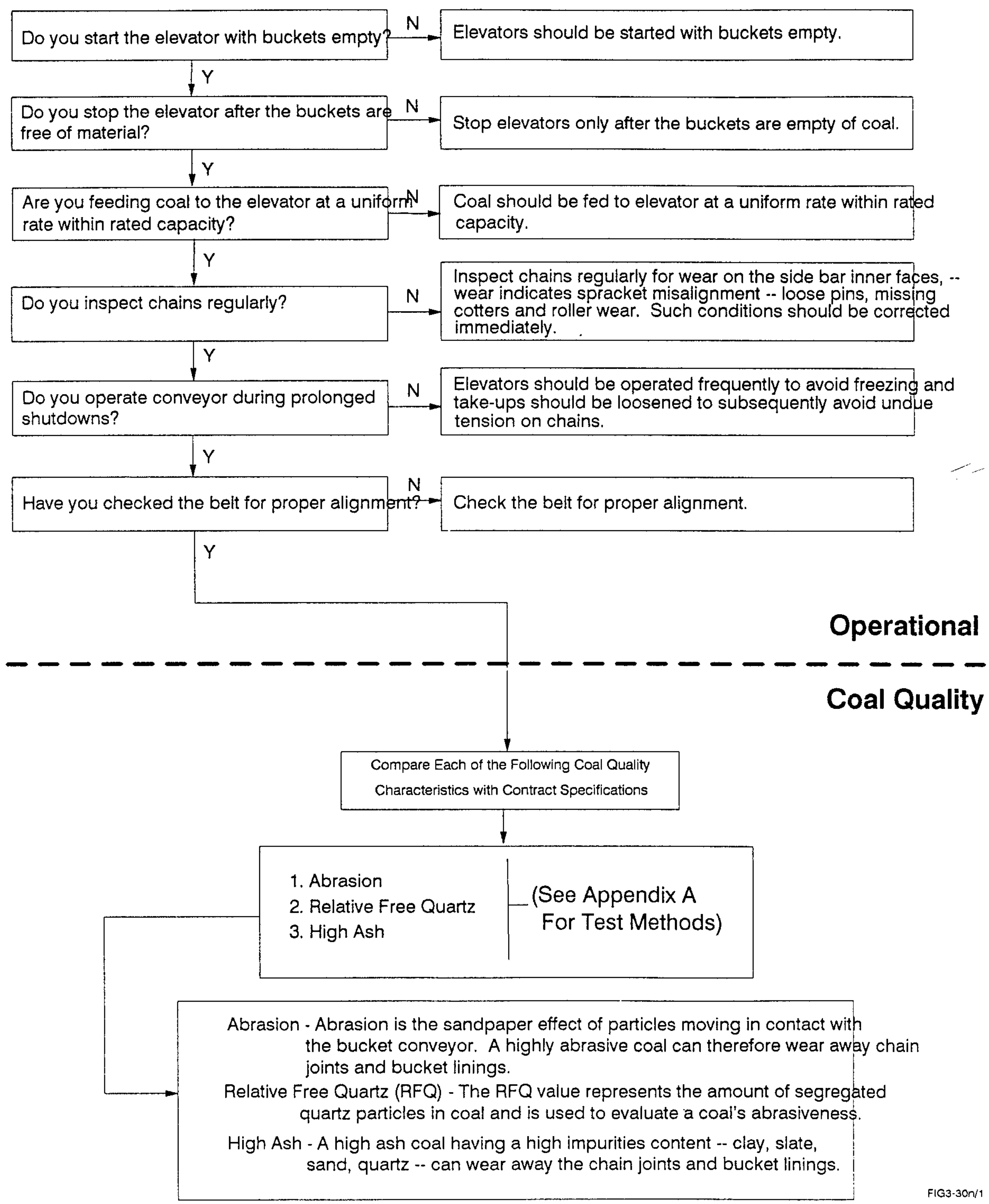


FIG3-30n/1

FIGURE 3-31: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor

(Bucket Conveyor)

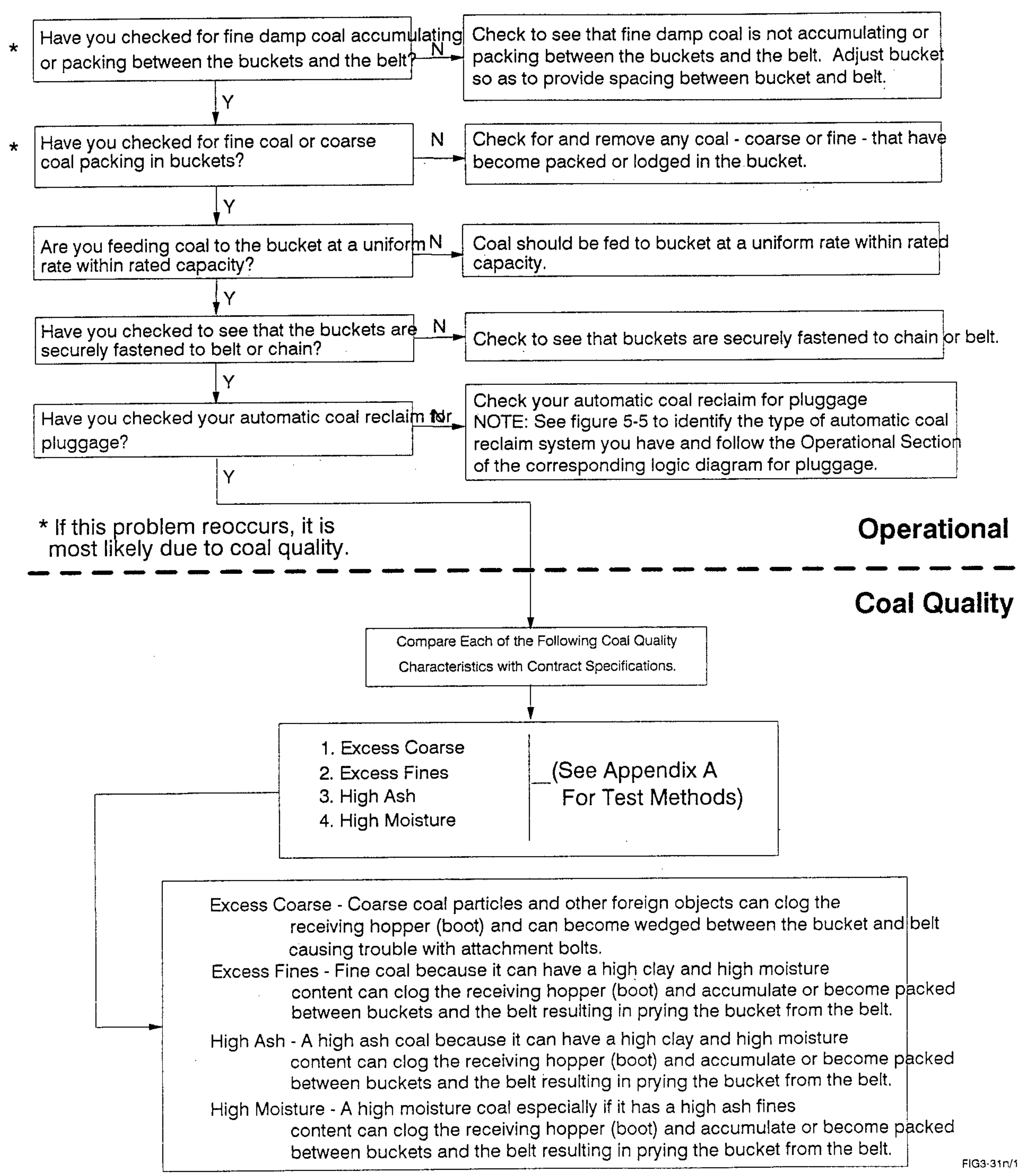


FIGURE 3-32: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor (Bucket Conveyor)

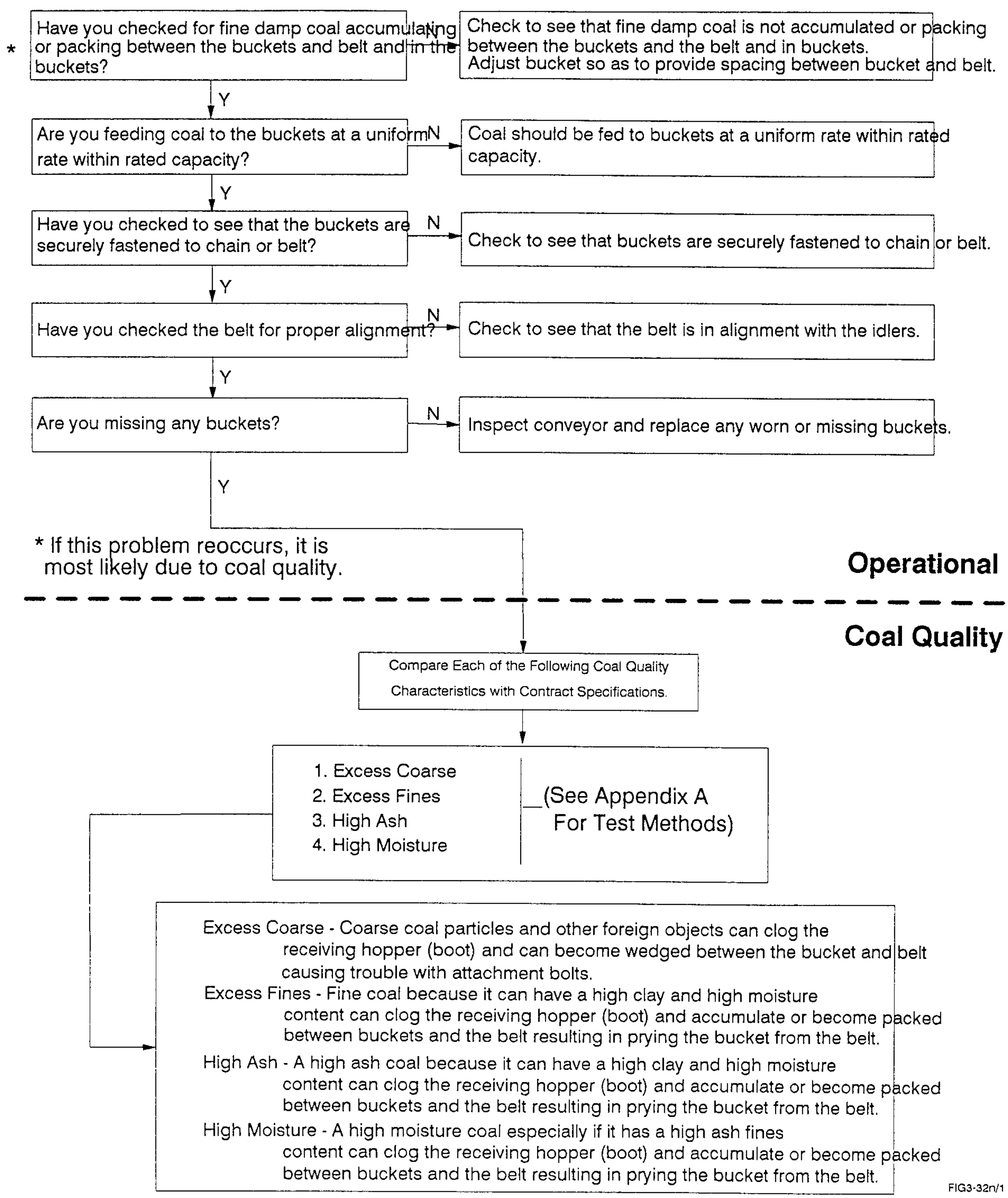


FIGURE 3-33: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

Erratic Feeding From The Coal Feed Conveyor
(Bucket Conveyor)

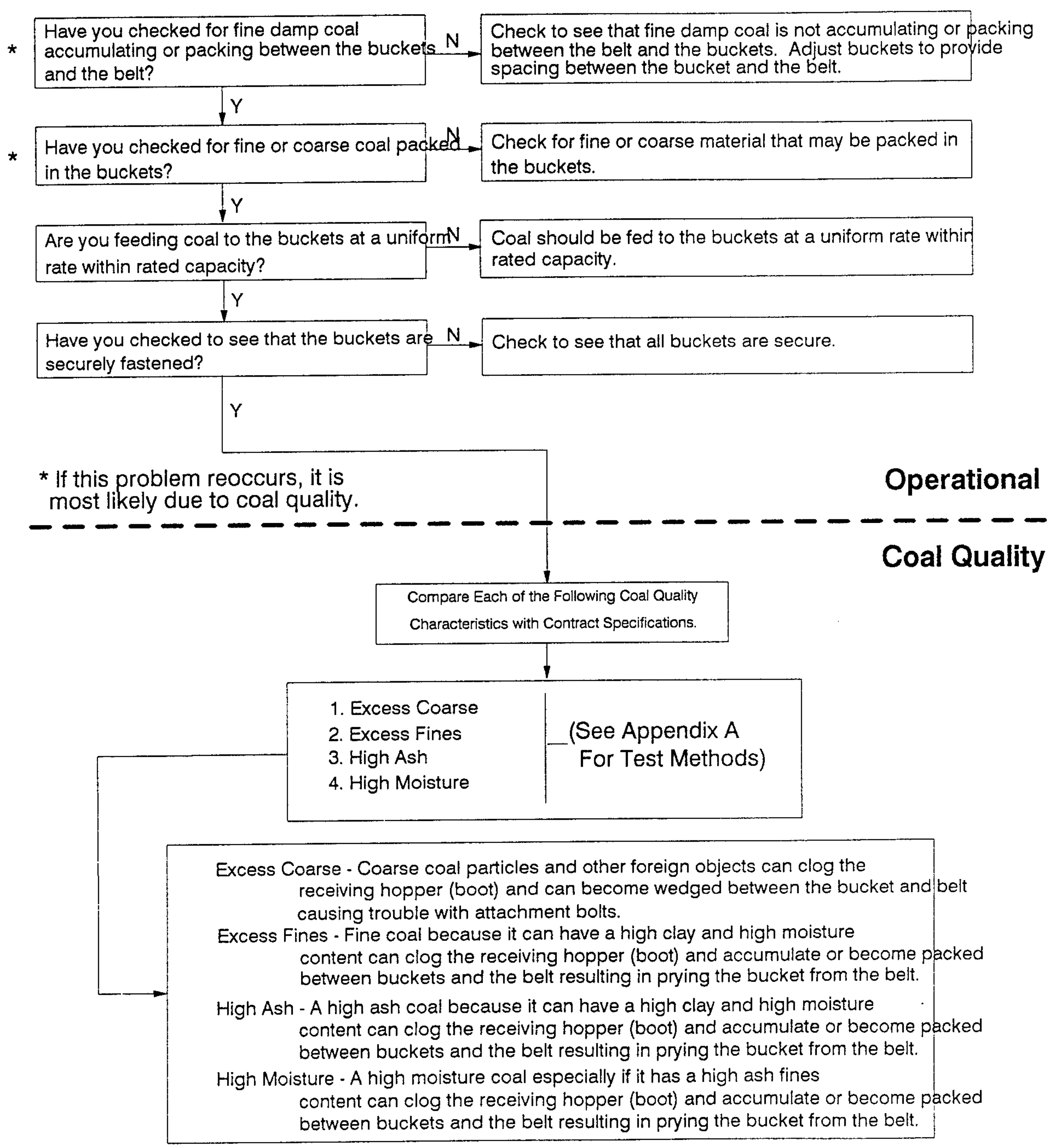


FIG3-33n/1

FIGURE 3-34: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of Coal Feed Conveyors

(Redler Conveyors)

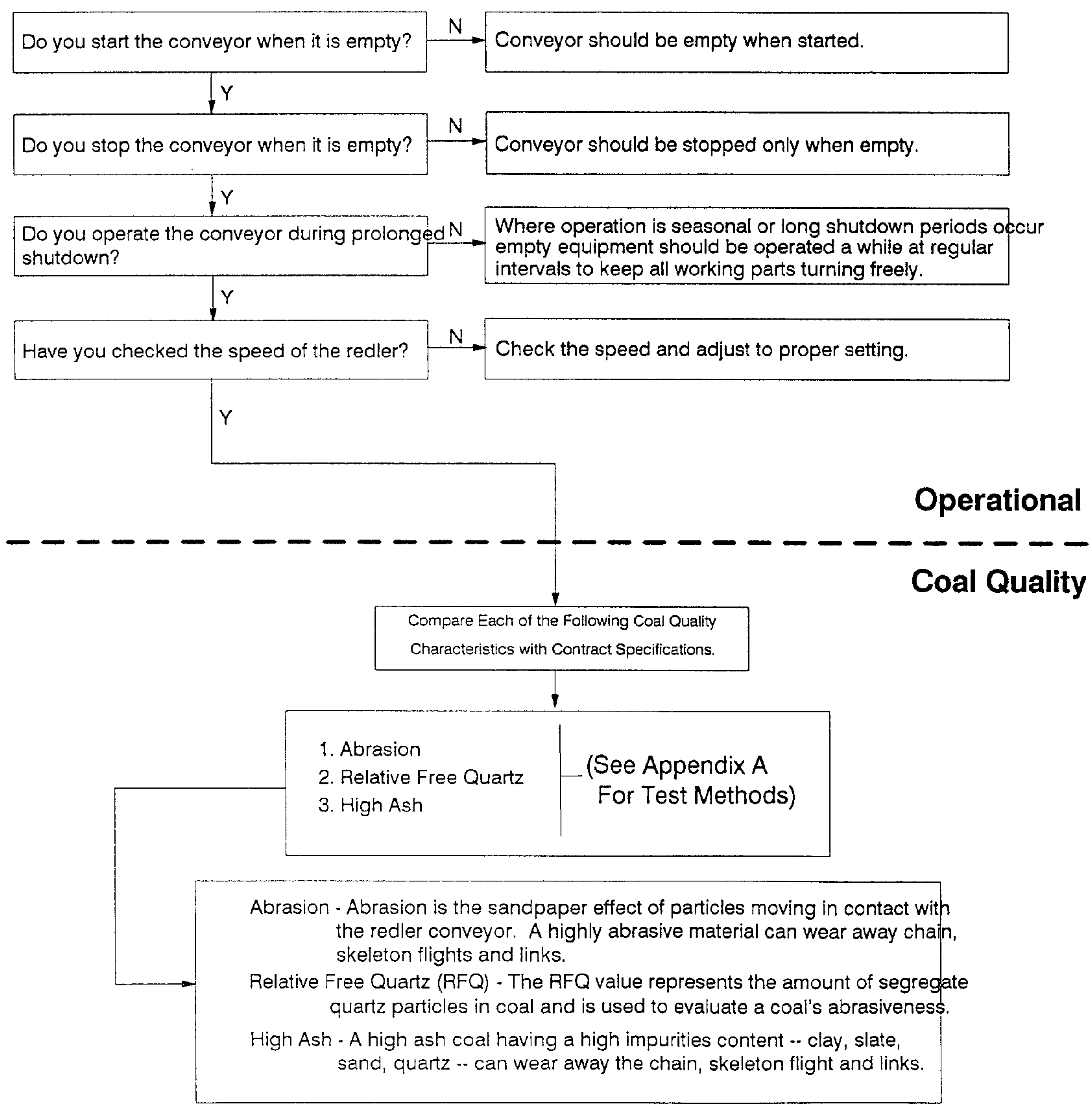


FIG3-34n/1

FIGURE 3-35: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Feed Conveyor
(Redler Conveyor)

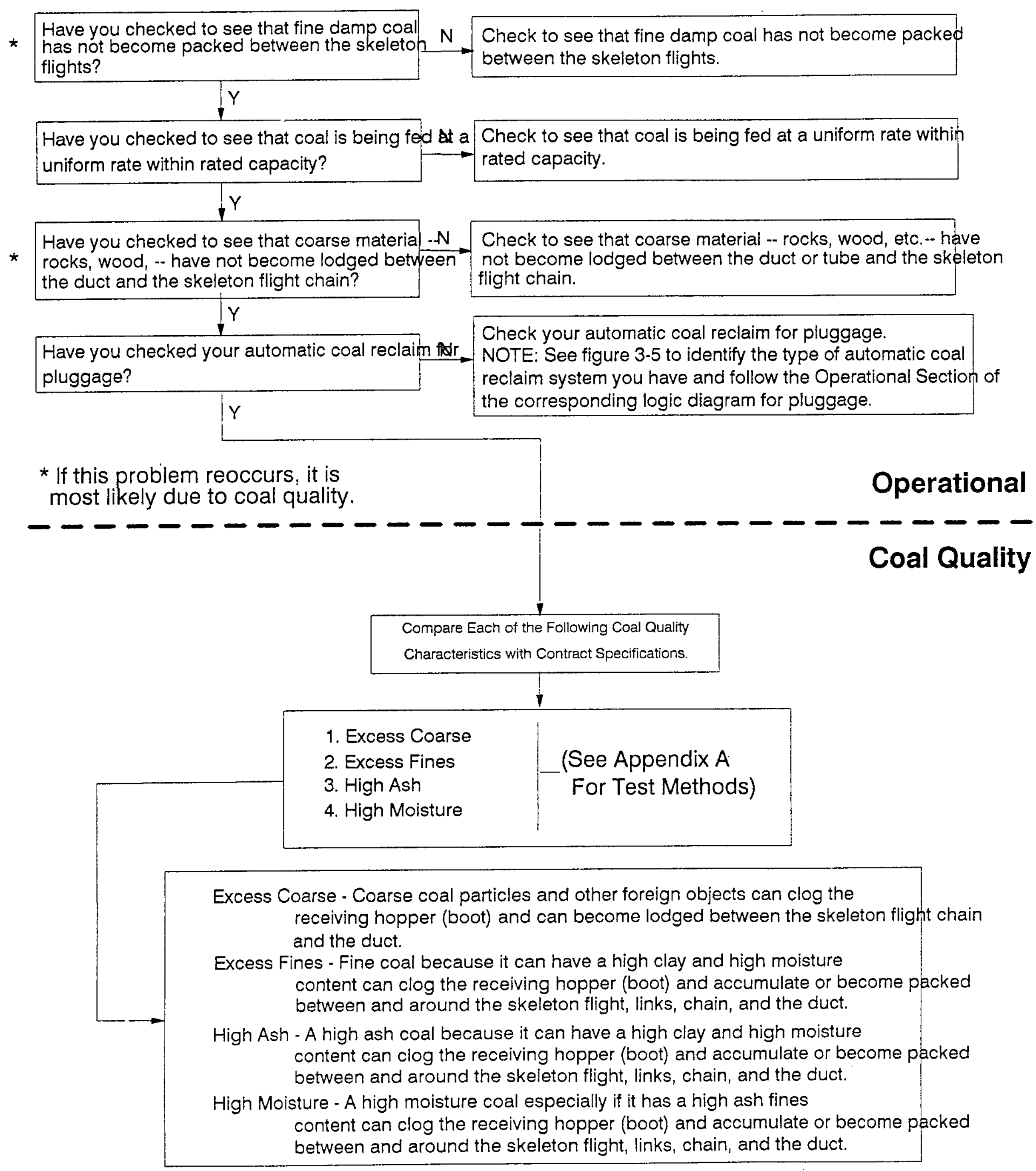


FIG3-35n/1

FIGURE 3-36: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor
(Redler Conveyor)

* Have you checked for fine damp coal that has become packed in between the skeleton flights?
- N → Check to see that fine damp coal has not become packed between skeleton flights.
- Y ↓

* Have you checked to see that coarse material - rocks, wood, frozen coal - has not become lodged between the duct and the skeleton flight?
- N → Check to see that coarse material -- rocks, wood, frozen coal -- has not become lodged between the duct and the skeleton flights.
- Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
- N → Check to see that coal is being fed at a uniform rate within rated capacity.
- Y ↓

Have you checked the speed of the redler?
- N → Check the speed and adjust to the proper setting.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG3-36n/1

FIGURE 3-37: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Redler Conveyor)

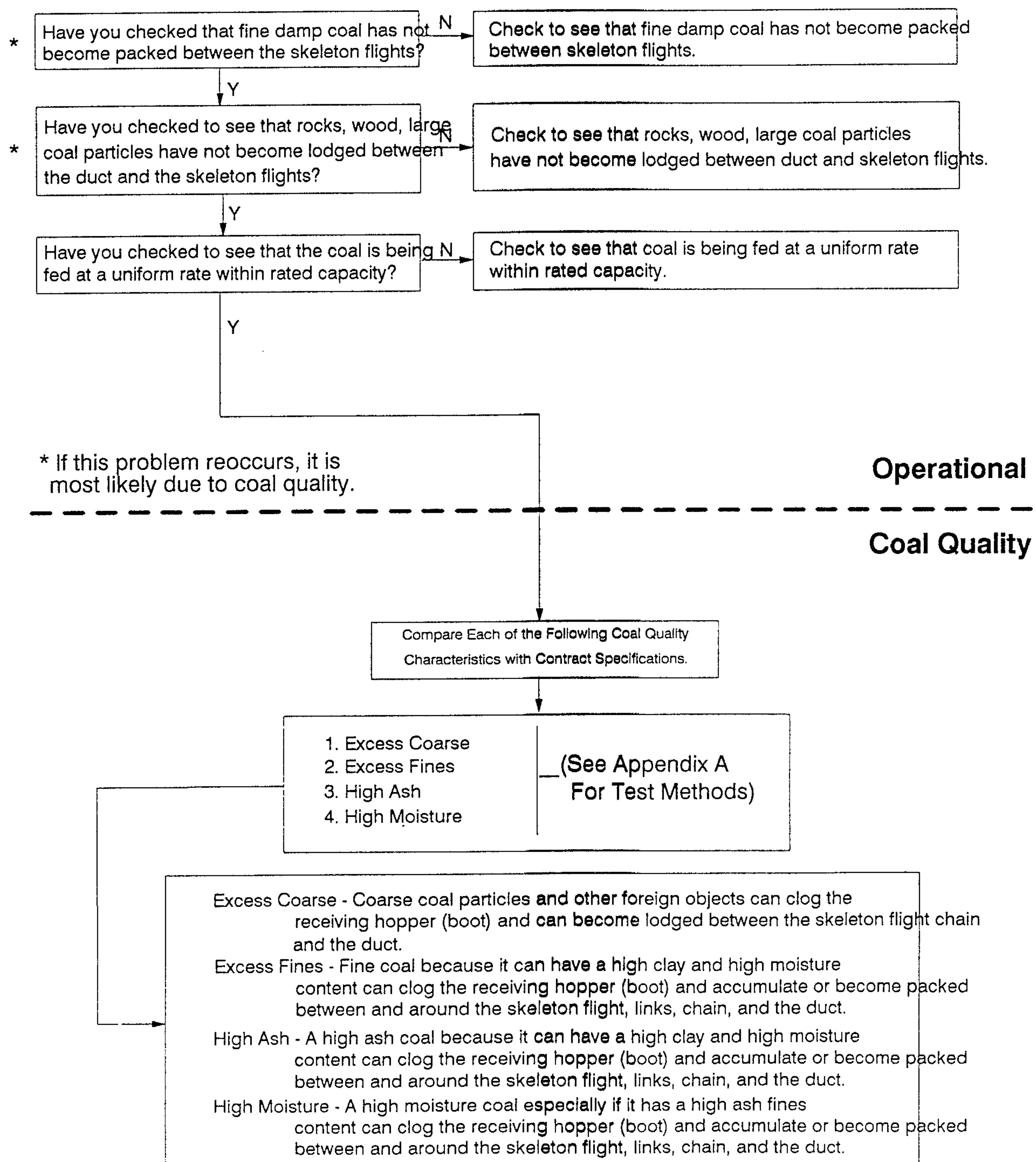


FIG3-37n/1

FIGURE 3-38: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Chutes)

* Have you checked for large rocks, wood, pieces of coal, frozen coal or other foreign objects preventing coal flow out of the chute?

N → Remove any large rocks, wood, pieces of coal, frozen coal or any other foreign objects that may be preventing coal flow out of the chute.

Y ↓

* Have you checked for fine damp coal that may have accumulated or become packed in the chute?

N → Remove any fine damp coal that may have accumulated or become packed in the chute.

Y ↓

Have you checked your automatic coal reclaim for pluggage?

N → Check your automatic coal reclaim for pluggage. NOTE: See figure 3-5 to identify the type of automatic coal reclaim system you have and follow the Operational Section of the corresponding logic diagram for pluggage.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the chute discharge opening.

FIG3-38n/1

FIGURE 3-39: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Chutes)

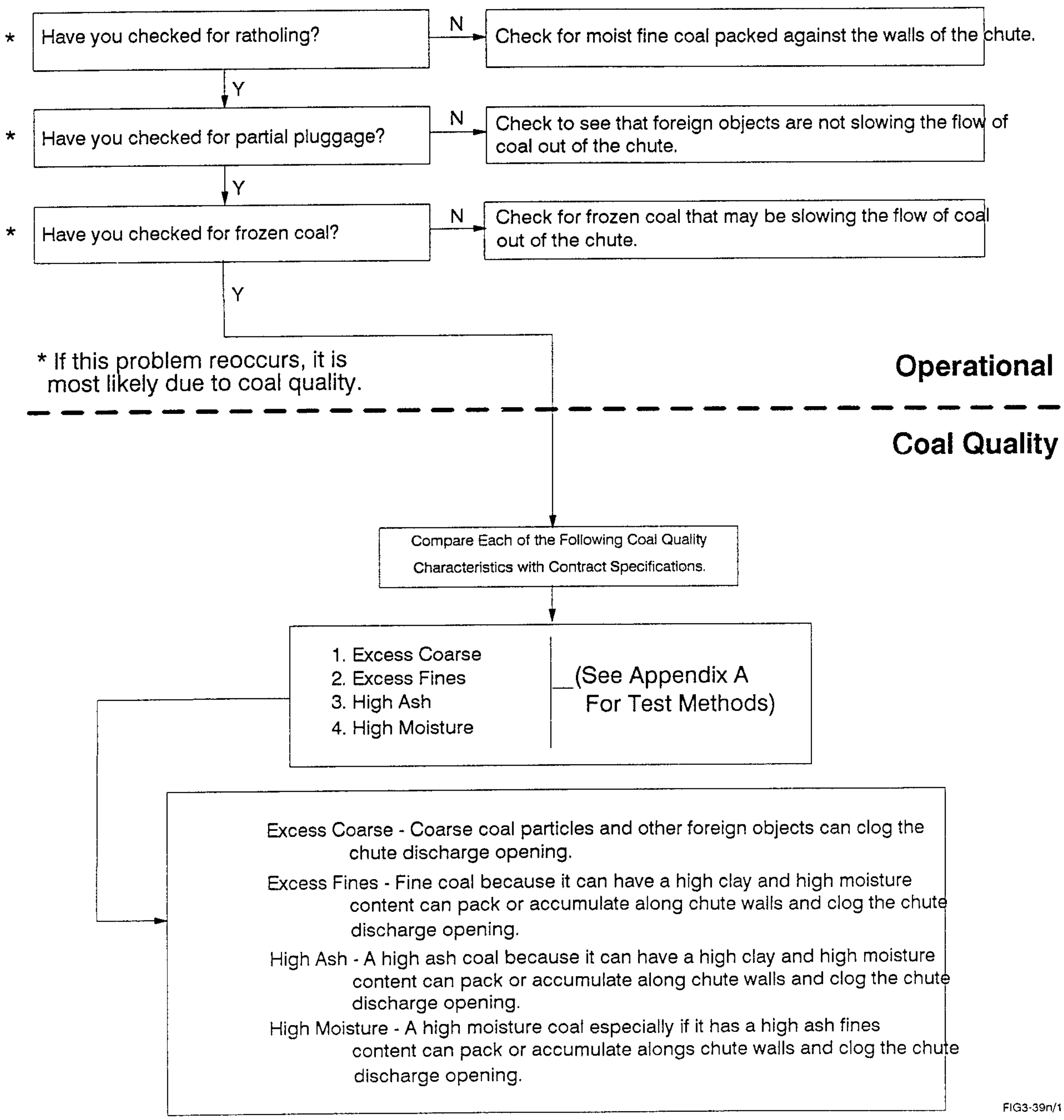


FIG3-39n/1

FIGURE 3-40: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor (Chute)

* Have you checked for damp fine coal that has become packed along chute walls or at the discharge end?

N → Check for fine damp coal that has accumulated along chute walls or at the discharge end.

Y ↓

* Have you checked for rocks, wood, large coal particles or other foreign objects that may be obstructing coal flow from the chute?

N → Check for wood, rocks, large coal particles or other foreign objects that may be obstructing coal flow from the chute.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate alongs chute walls and clog the chute discharge opening.

FIG3-40n/1

FIGURE 3-41: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feeders

(Chute)

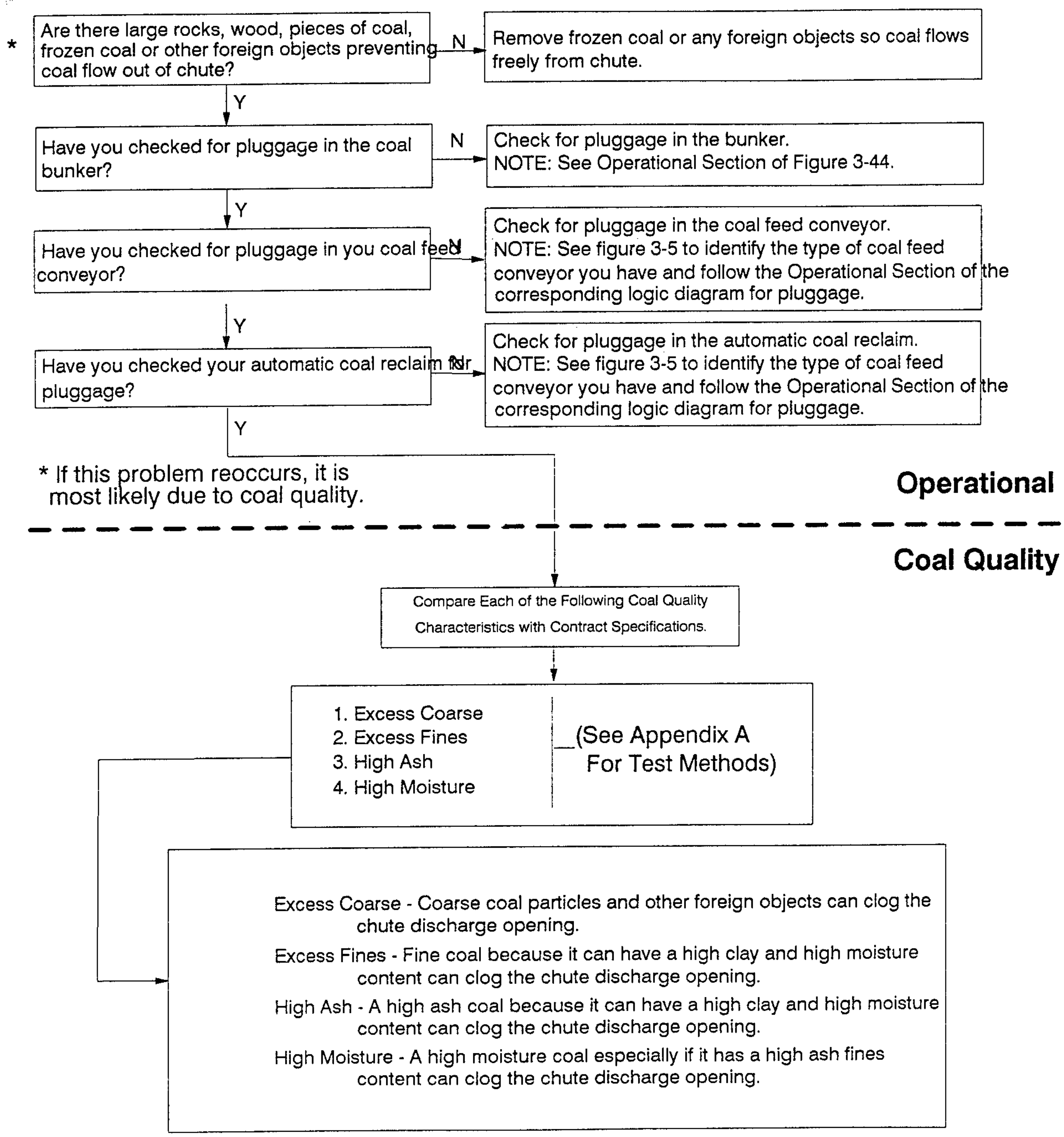


FIG3-41n/1

FIGURE 3-42: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In the Coal Feeder (Chutes)

* Have you checked for fine damp coal that has become packed along the walls in the chute?

N → Check for fine damp coal that has become packed along the walls of the chute.

Y ↓

* Have you checked for coarse material -- rocks, wood, frozen coal, -- that is obstructing flow from the chute?

N → Check for coarse material -- rocks, wood, frozen coal -- and other foreign objects that are obstructing flow from the chutes.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can pack or accumulate along chute walls and clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate alongs chute walls and clog the chute discharge opening.

FIG3-42n/2

FIGURE 3-43: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feeder (Chutes)

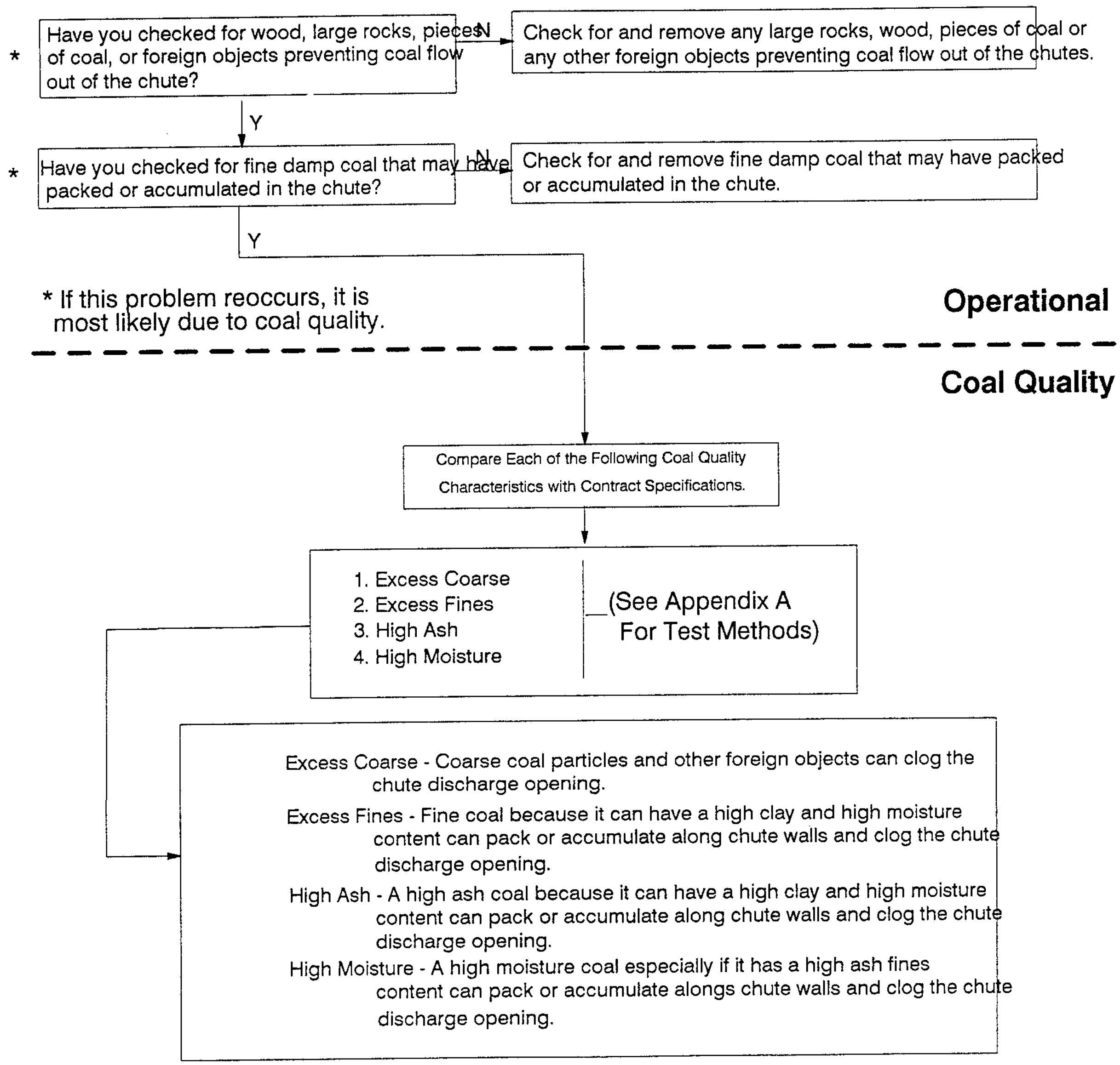


FIG3-43n/2

FIGURE 3-44: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Bunker

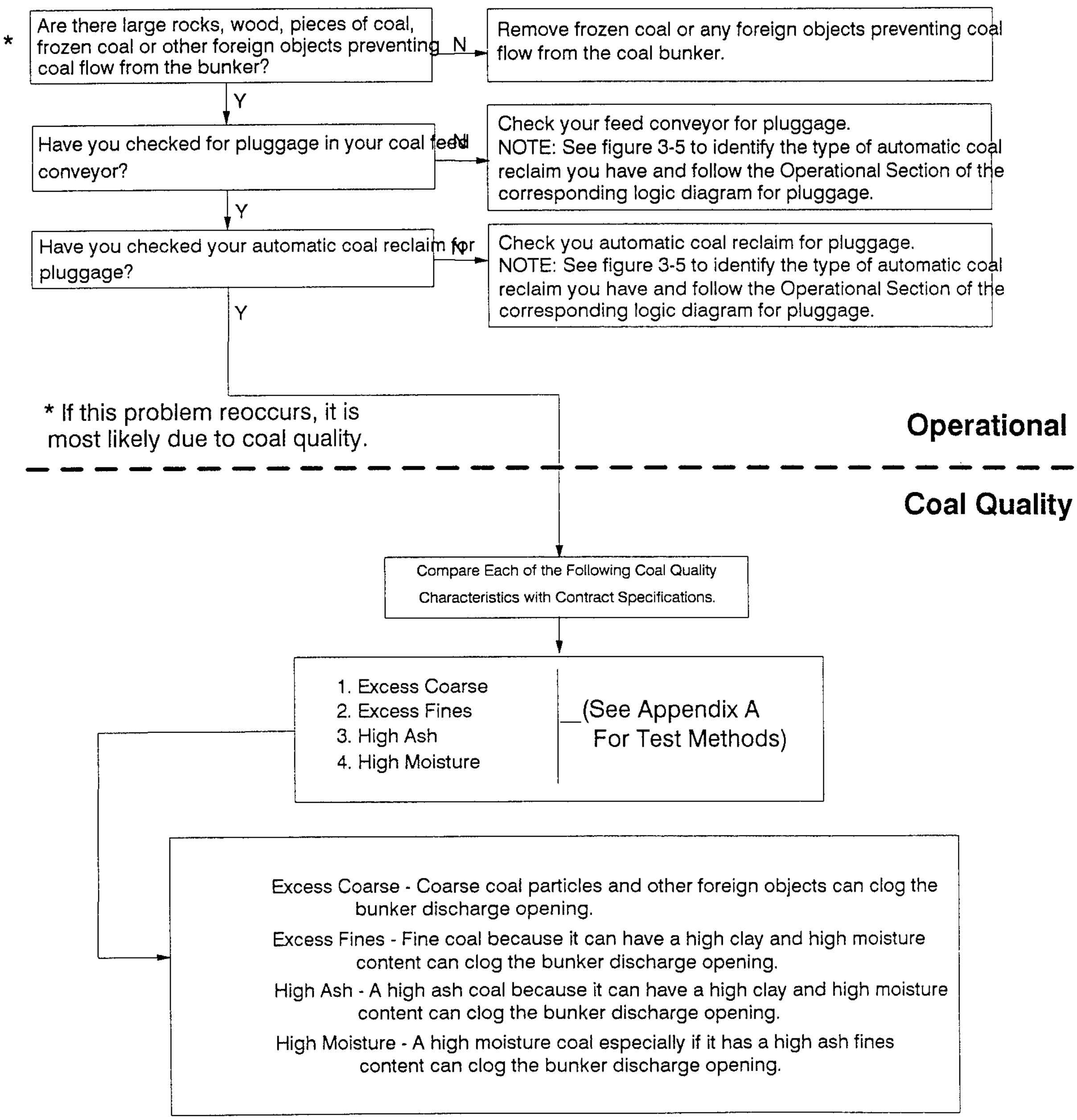


FIG3-44n/2

FIGURE 3-45: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Bunker

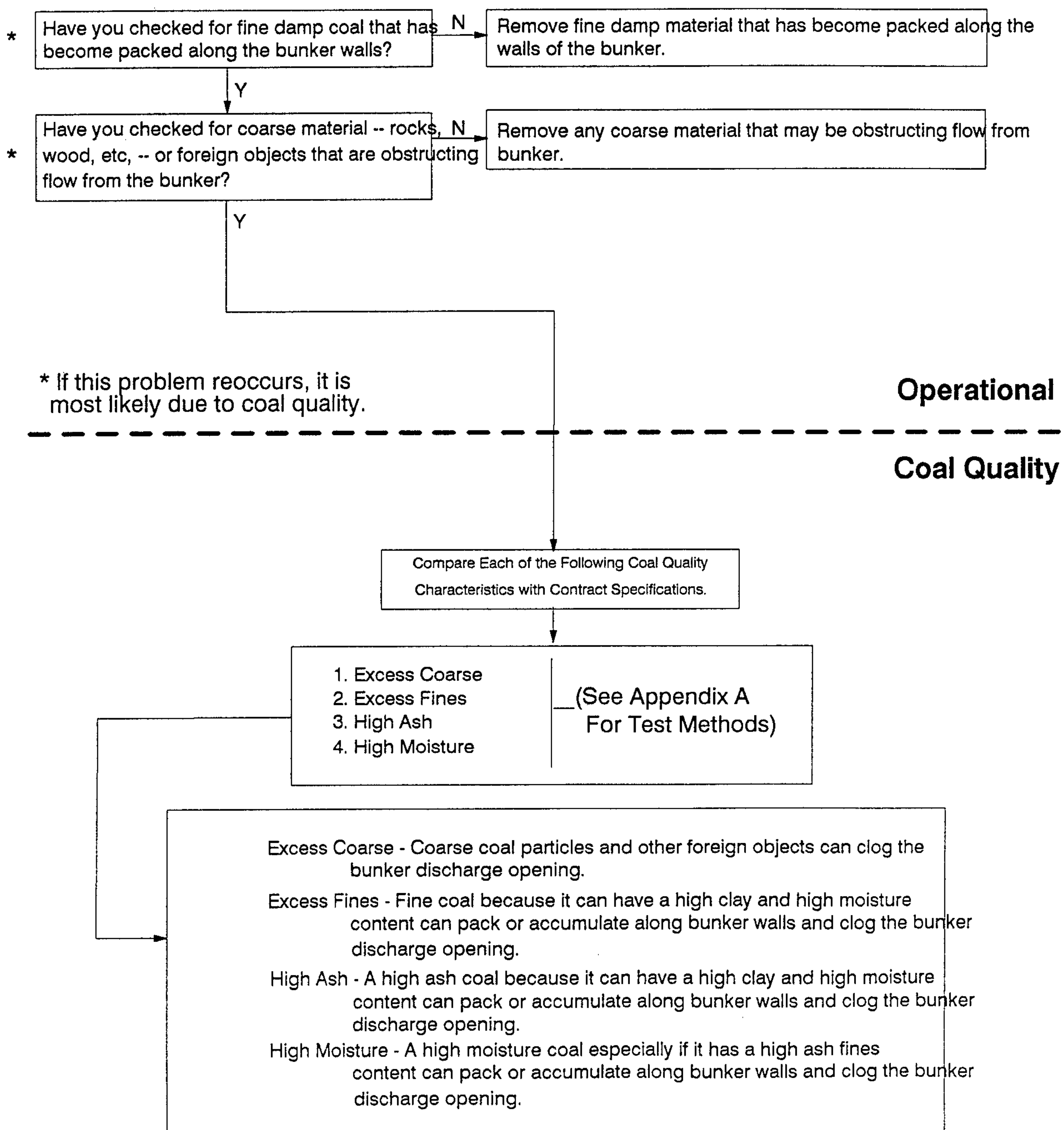


FIG3-45n/2

FIGURE 3-46: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Bunker

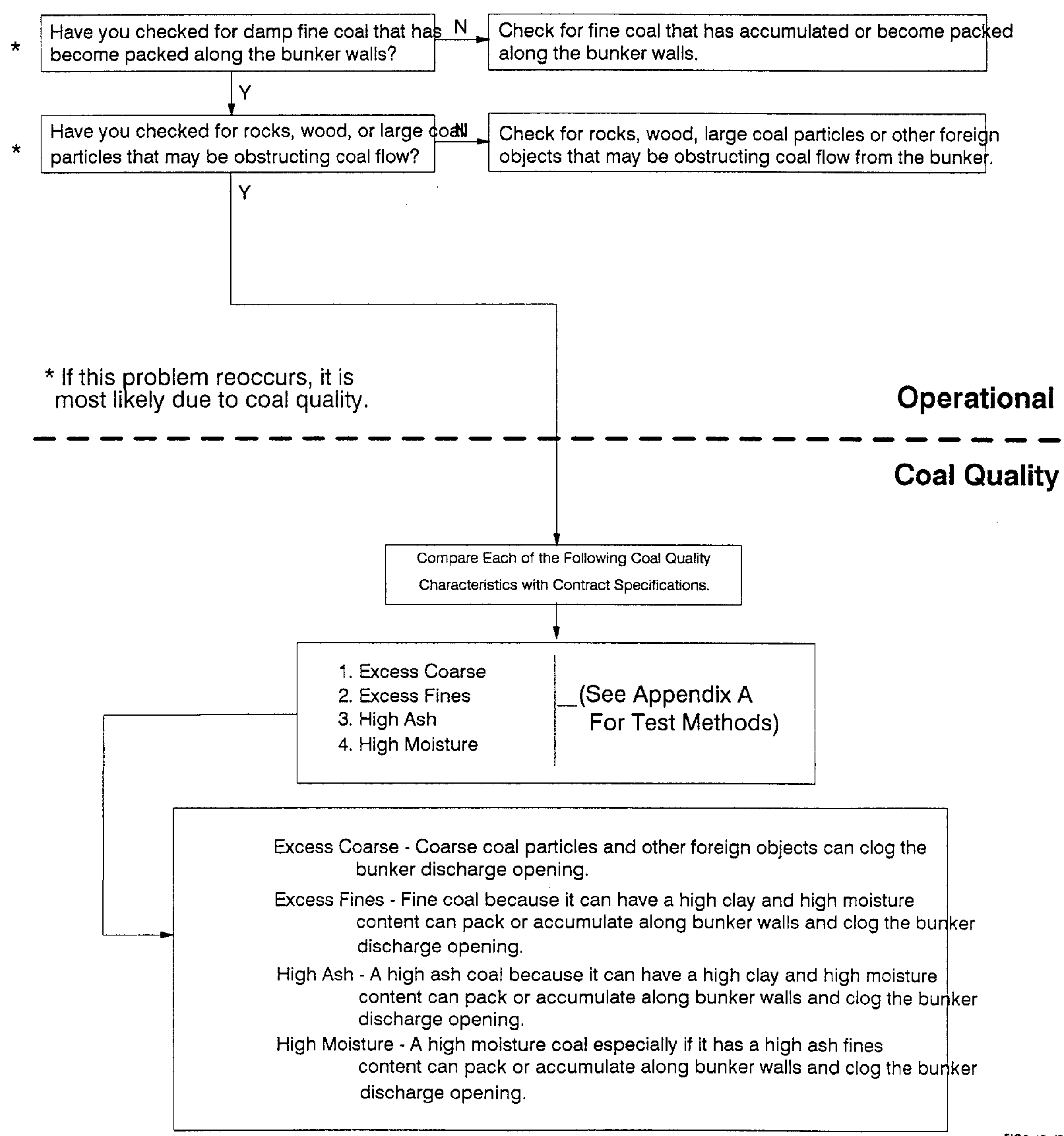


FIG3-46n/2

FIGURE 3-47: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Hopper

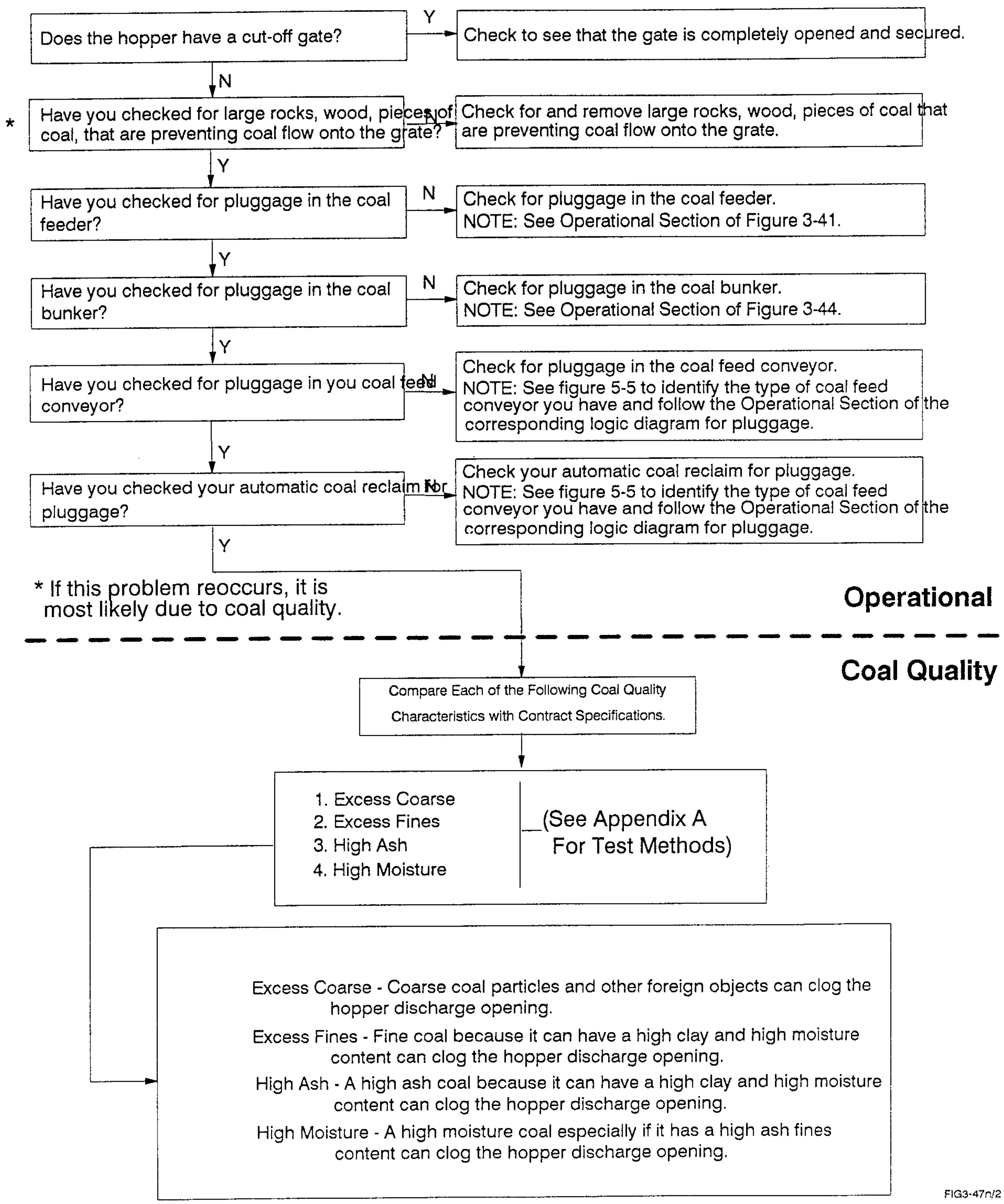


FIG3-47n/2

FIGURE 3-48: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

Insufficient Capacity In The Coal Hopper

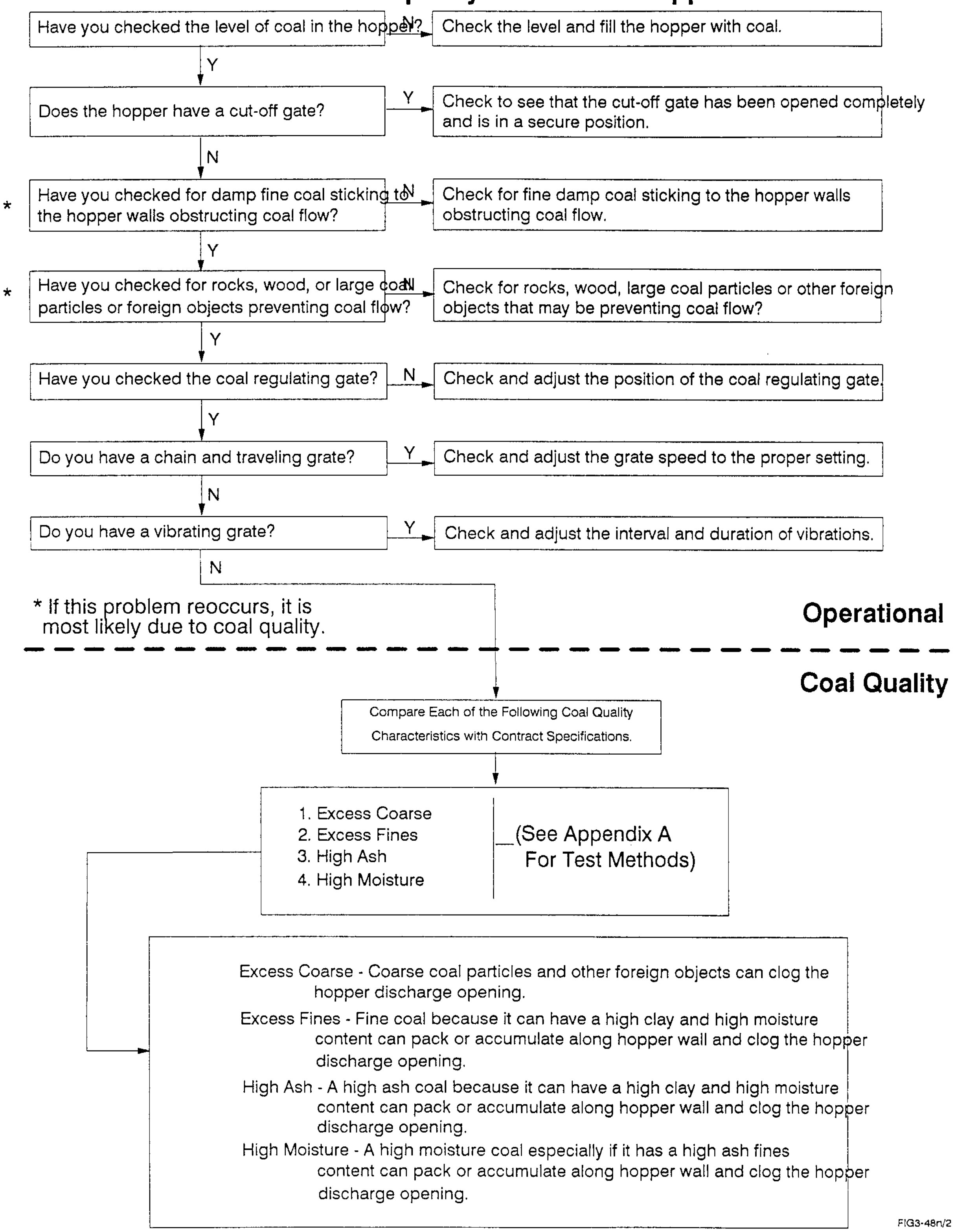


FIGURE 3-49: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Hopper

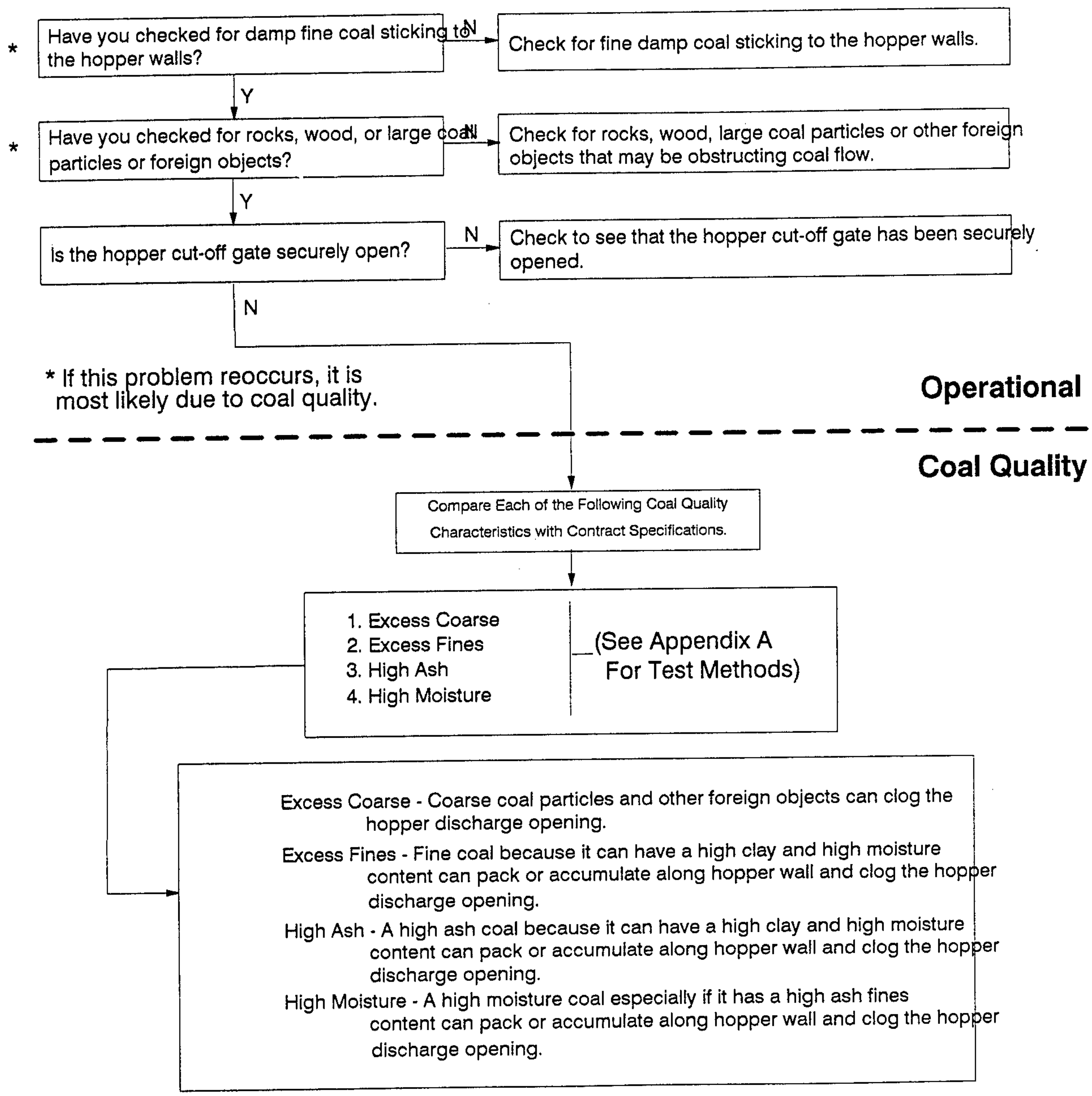


FIG3-49n/2

FIGURE 3-50: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Feeder Distributor Mechanism

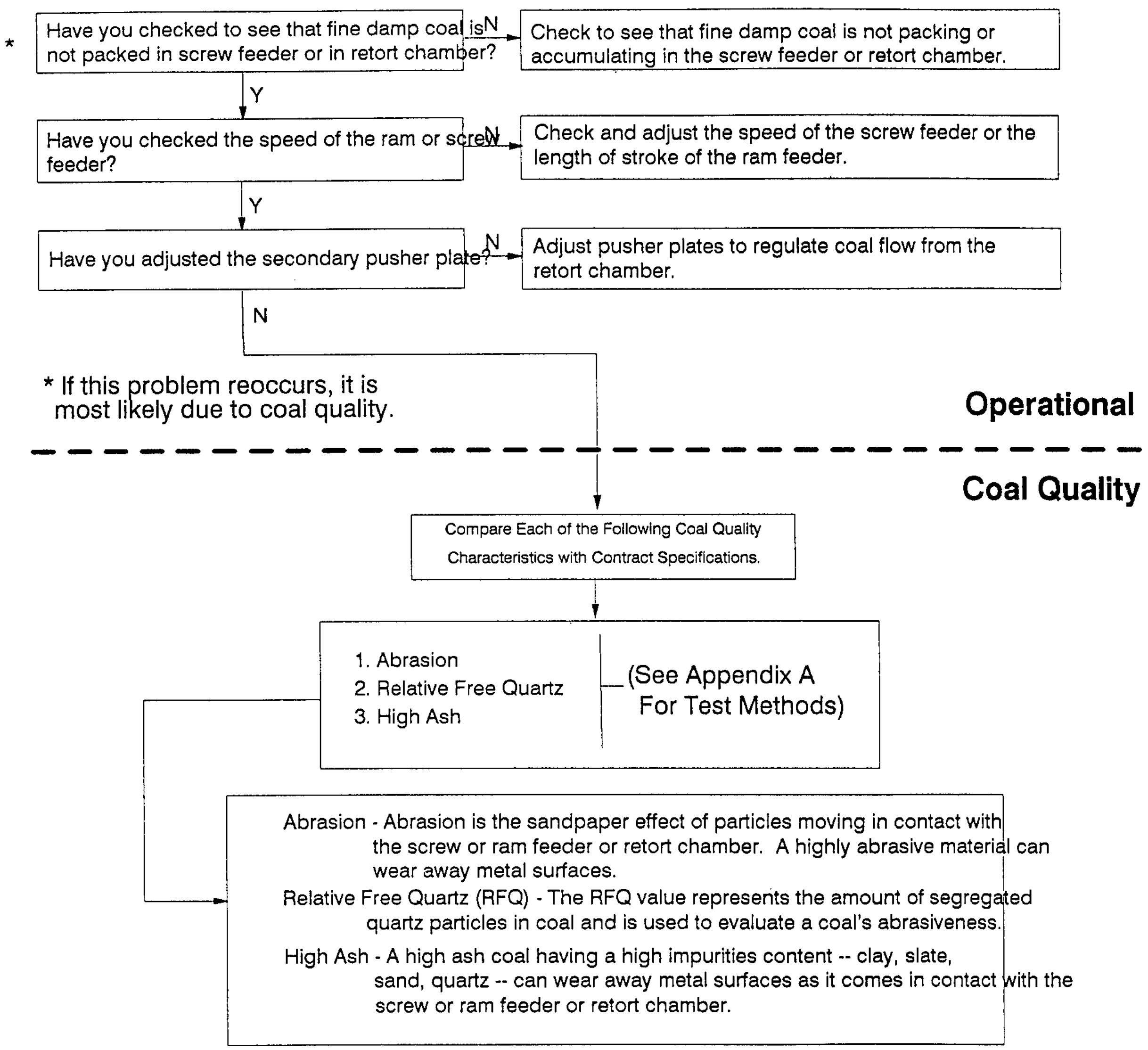


FIG3-50n/2

FIGURE 3-51: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Feeder Distributor Mechanism

* Have you checked to see that fine damp coal is not packed in screw feeder or in retort chamber? — N → Check to see that fine damp coal is not packing or accumulating in the screw feeder or retort chamber.

↓ Y

Have you checked the speed of the ram or screw feeder? — N → Check and adjust the speed of the screw feeder or the length of stroke of the ram feeder.

↓ Y

Have you adjusted the secondary pusher plate? — N → Adjust pusher plates to regulate coal flow from the retort chamber.

↓ N

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

↓

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

↓

Excess Coarse - Coarse coal particles can become lodged between the ram or screw feeder and the casing surrounding the feeder, and can also become lodged in the retort chamber.

Excess Fines - Fine coal high in clay and moisture can become packed around the screw feeder or in the retort chamber, and around secondary pusher plates.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed around the screw feeder or in the retort chamber and around the secondary pusher plates.

High Moisture - A high moisture coal especially if it has a high ash fines content can pack or accumulate around the screw feeder or in the retort chamber and around secondary pusher plates.

FIG3-51n/2

FIGURE 3-52: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Feeder Distributor Mechanism

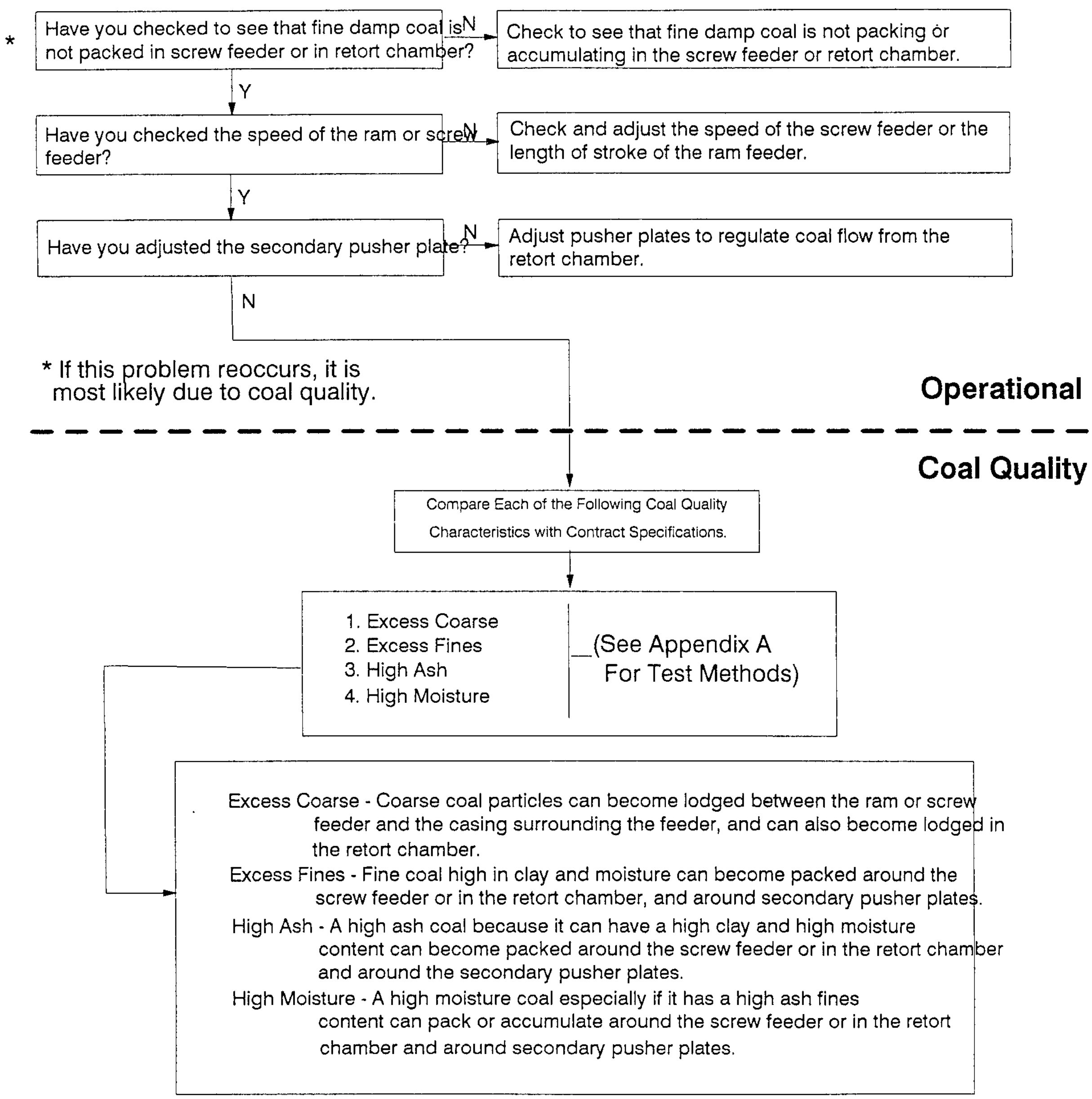


FIG3-52n/2

FIGURE 3-53: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Feeder Distributor Mechanism

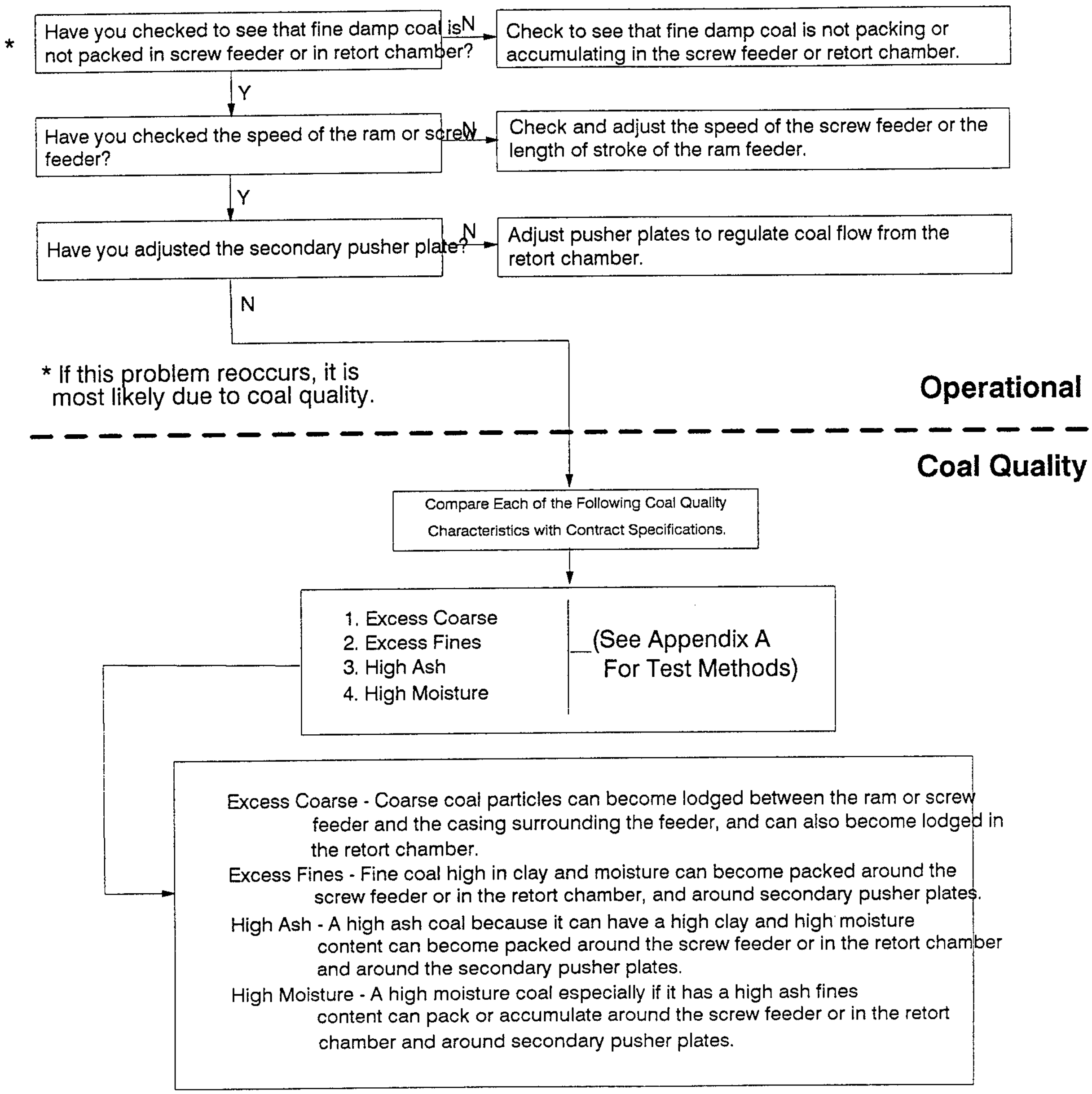
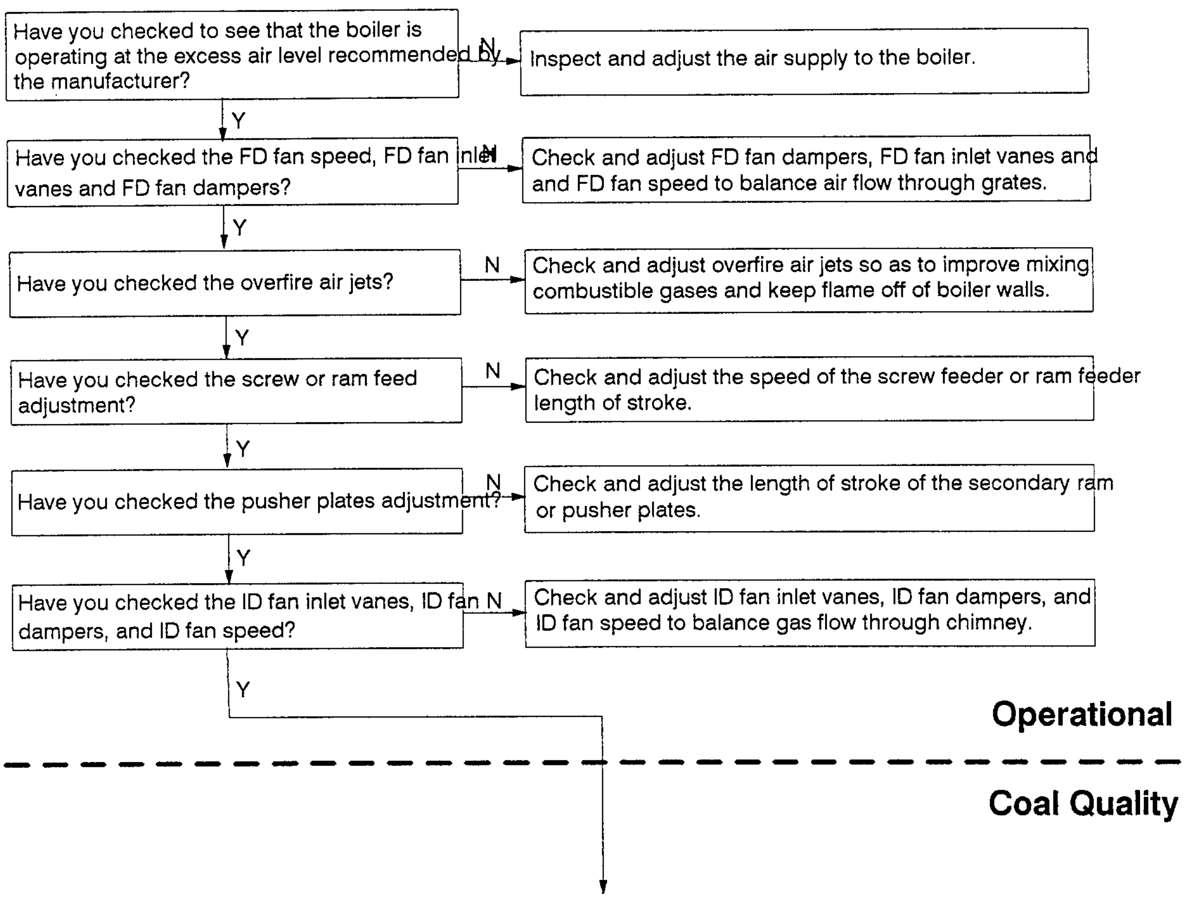


FIG3-53n/2

FIGURE 3-54: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load

(Boiler)



See nest page for Coal Quality Section

FIG3-54n/2

IGURE 3-54 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAI
For Insufficient Capacity And Inability To Meet Load
(Boiler)

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. High ASH
5. Excess Coarse
6. Excess Fine
7. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

High Ash - If excessive ash particles can become sufficiently thick on the grate to seriously restrict air flow through the grate and fuel bed making it difficult to complete combustion.

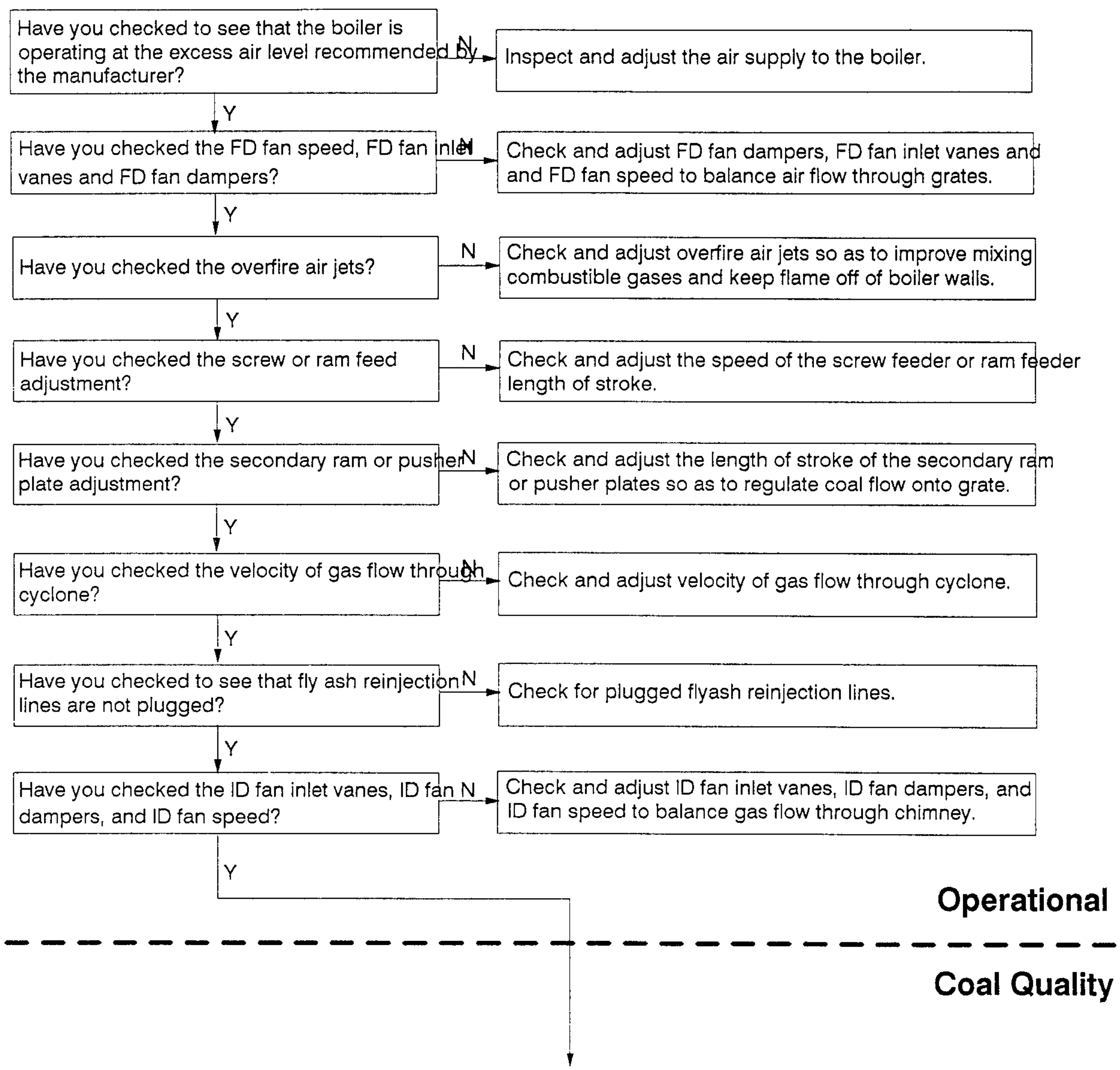
Excess Coarse - Coarse coal tends to segregate in coal conveying equipment and hoppers causing uneven burning, an uneven ash and coal bed on the grate.

Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG3-54nb/2

FIGURE 3-55: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Reduced Boiler Efficiency



See nest page for Coal Quality Section

FIG3-55n/2

IGURE 3-55 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Reduced Boiler Efficiency

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Volatile Matter
2. High Fixed Carbon
3. Excess Fine
4. Low Moisture

(See Appendix A For Test Methods)

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion

FIG3-55nb/2

FIGURE 3-56: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion On The Grate

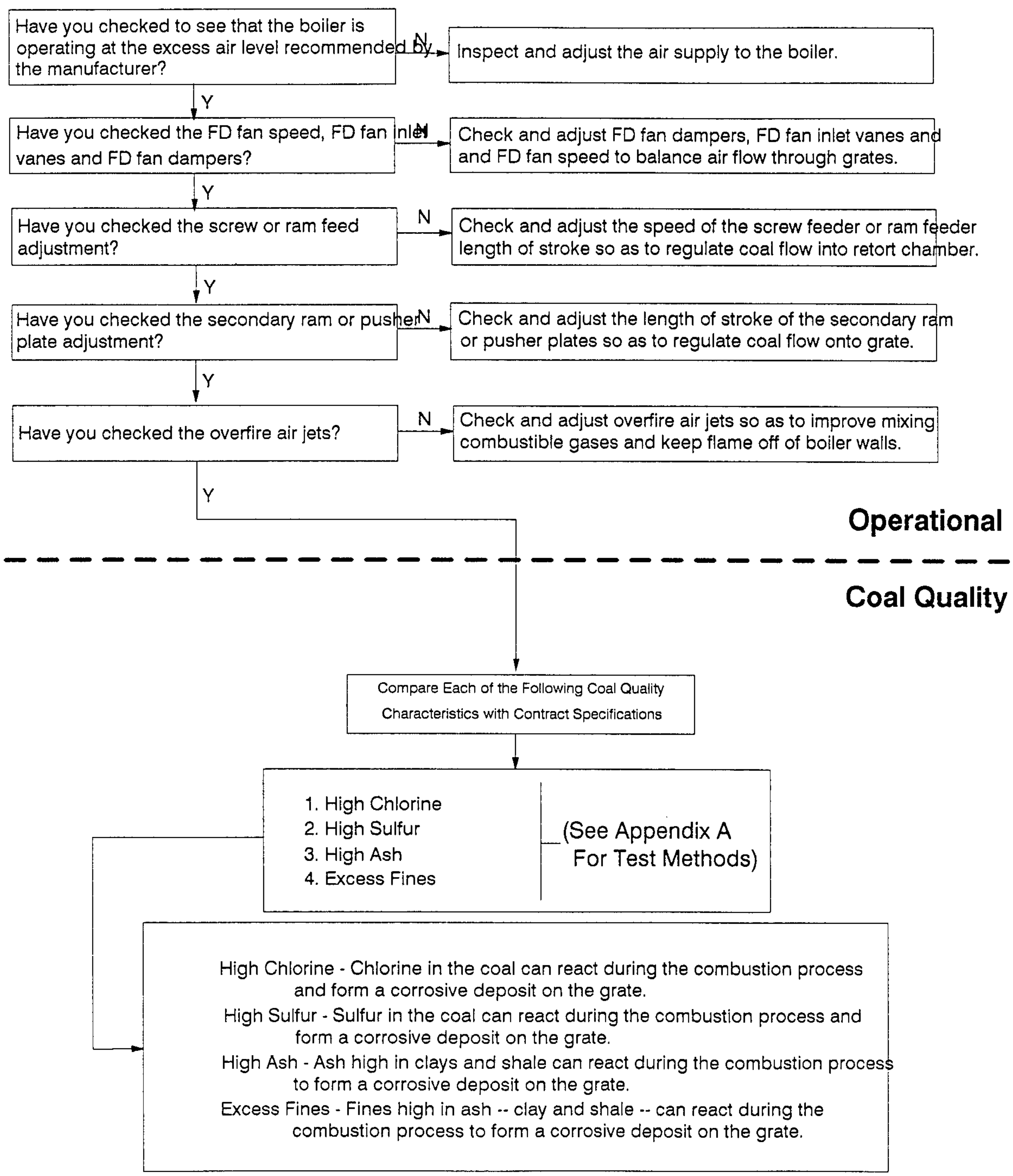


FIG3-56n/2

FIGURE 3-57: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Segregation On The Grate

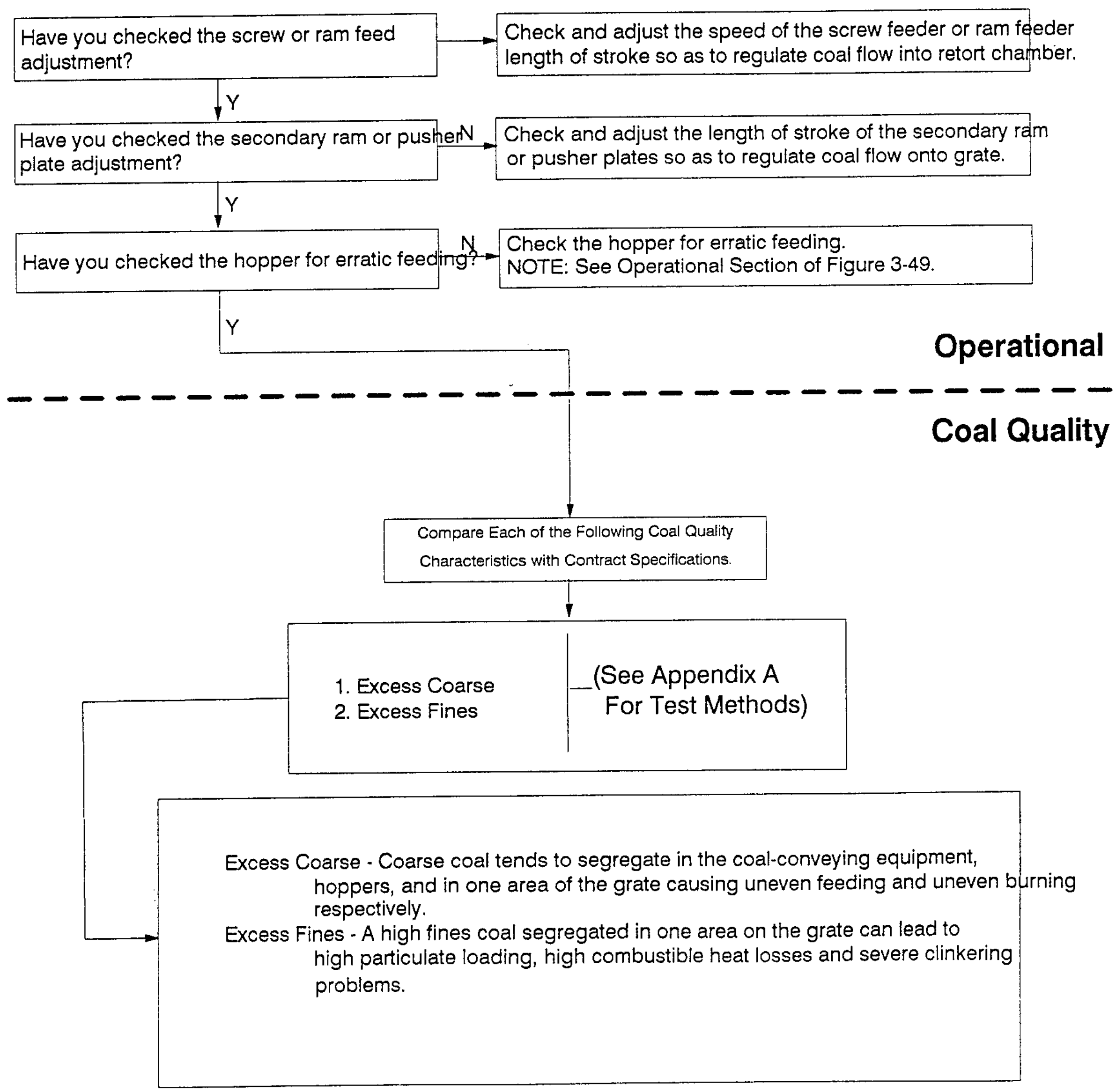


FIG3-57n/2

FIGURE 3-58: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Pressure Drop Across The Grate

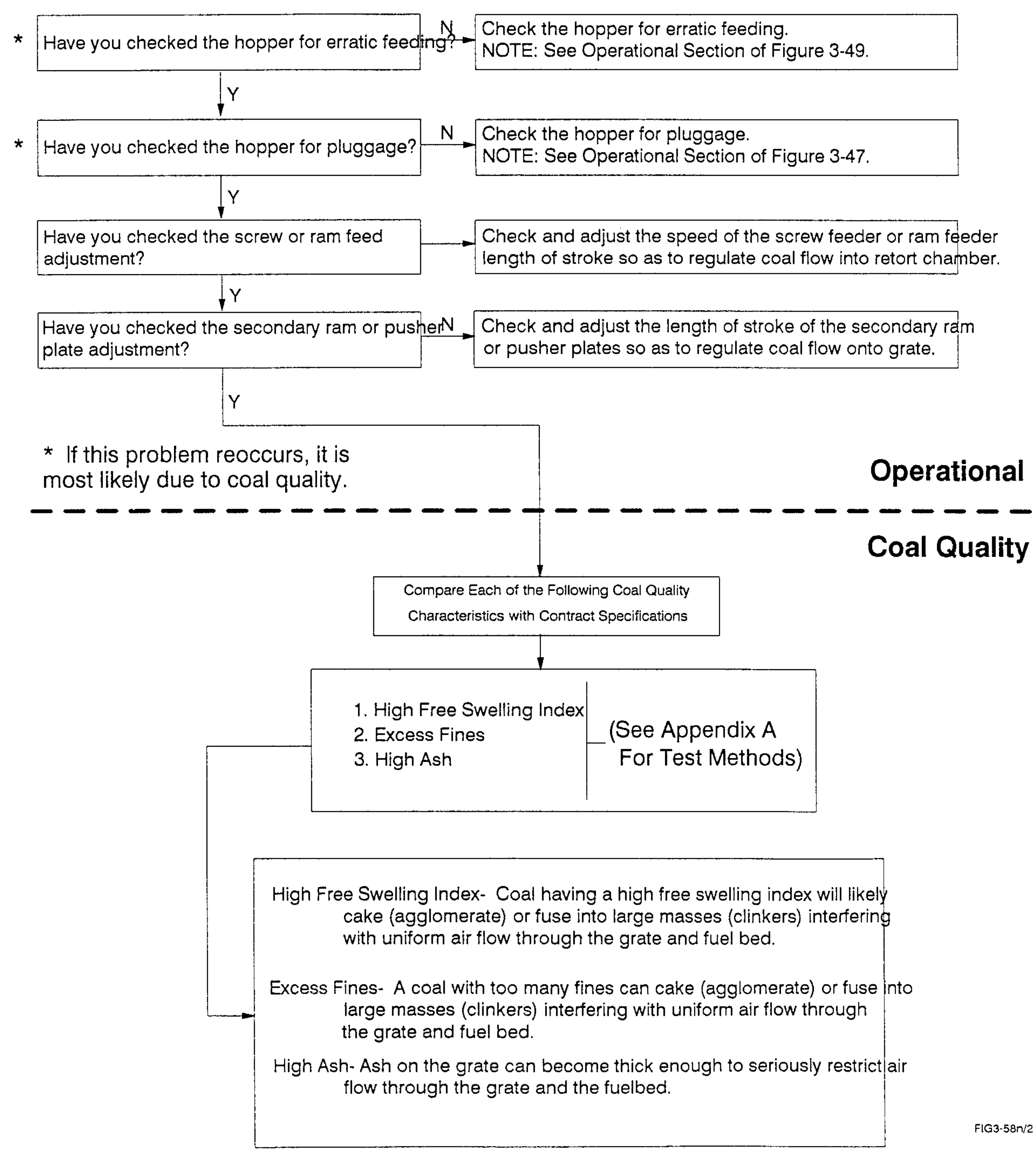


FIGURE 3-59: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Ashbed On The Grate

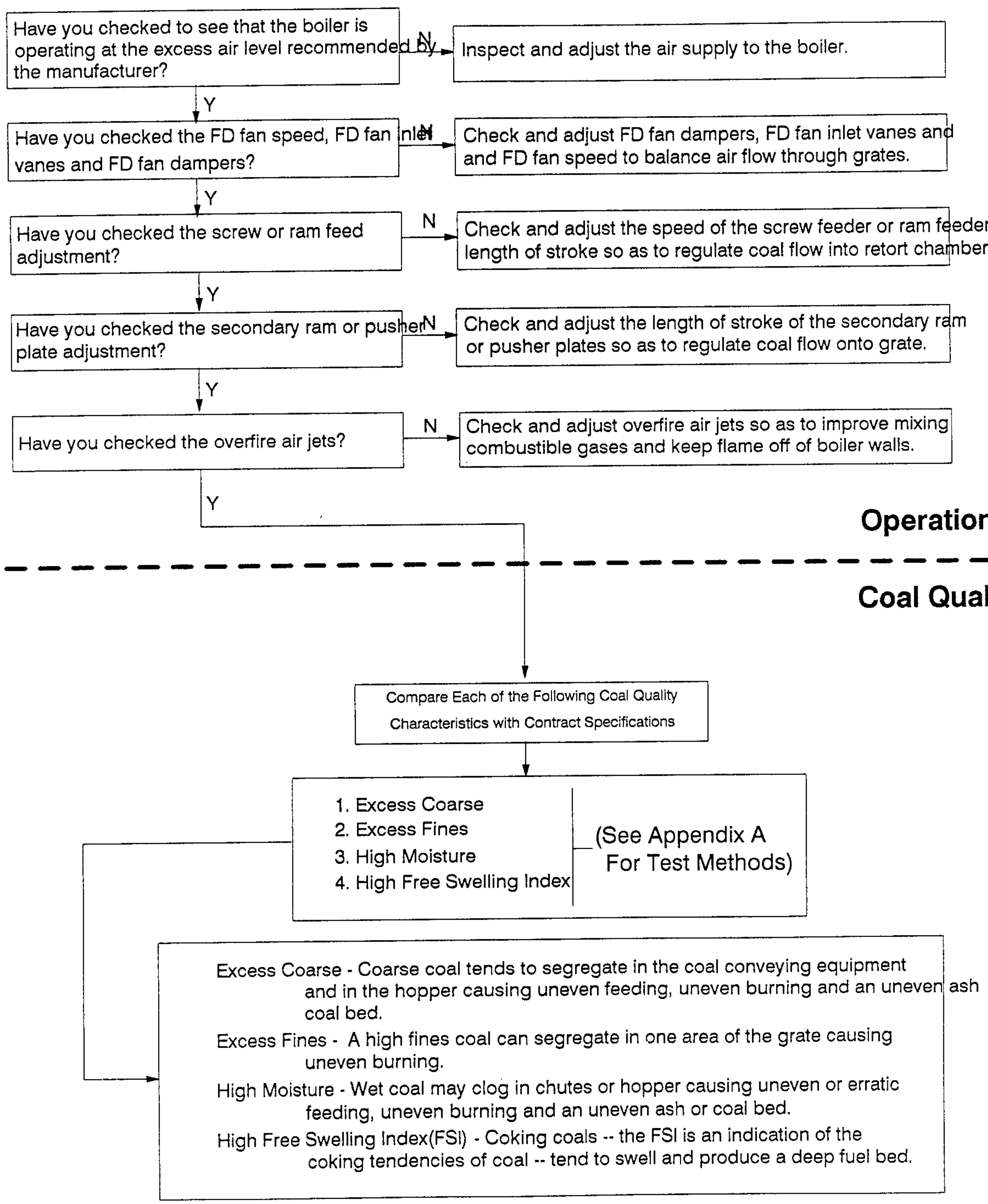


FIG3-59n/2

FIGURE 3-60: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Uneven Coalbed On The Grate

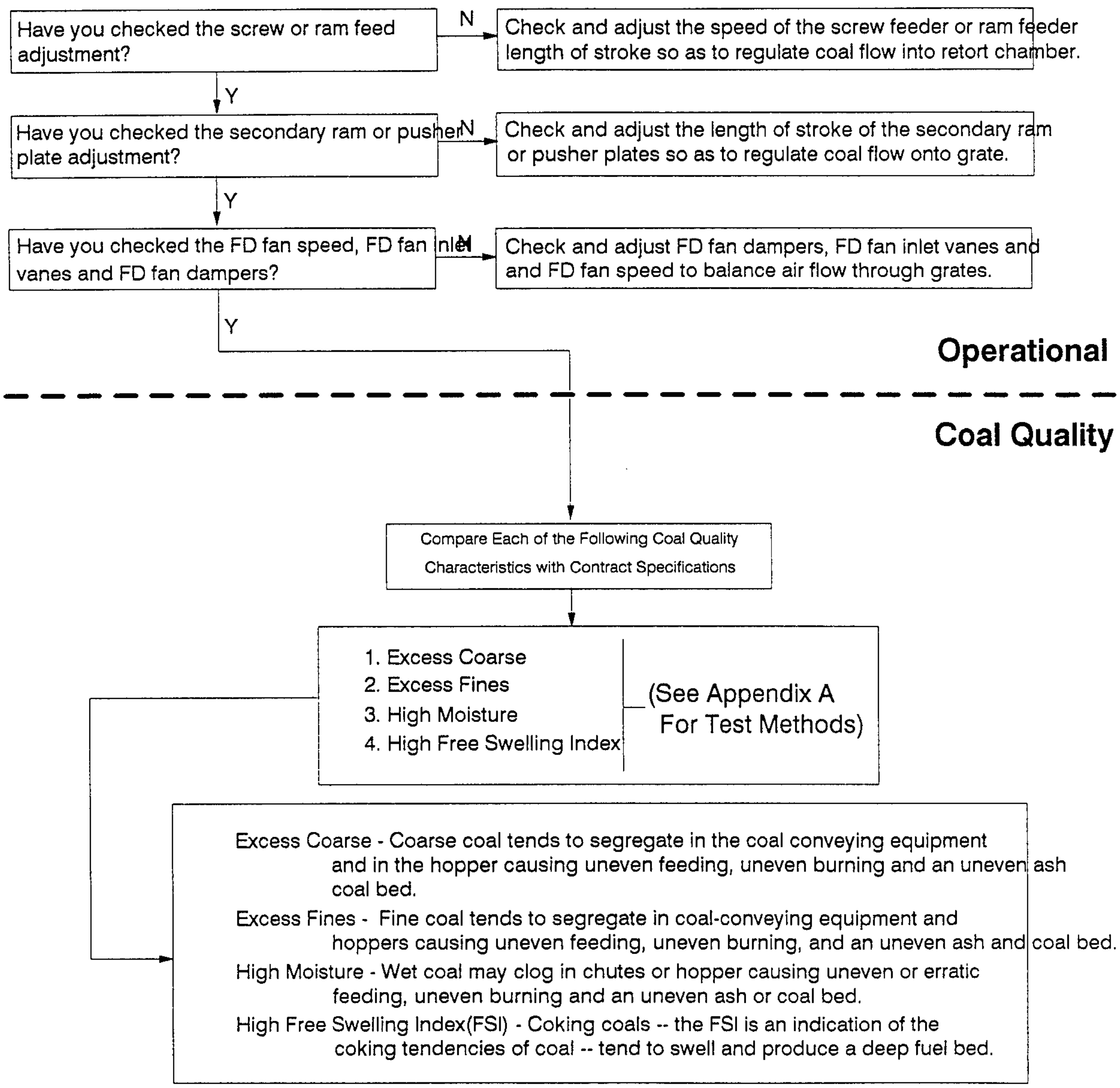


FIG3-560n/2

FIGURE 3-61: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Burning On the Grates

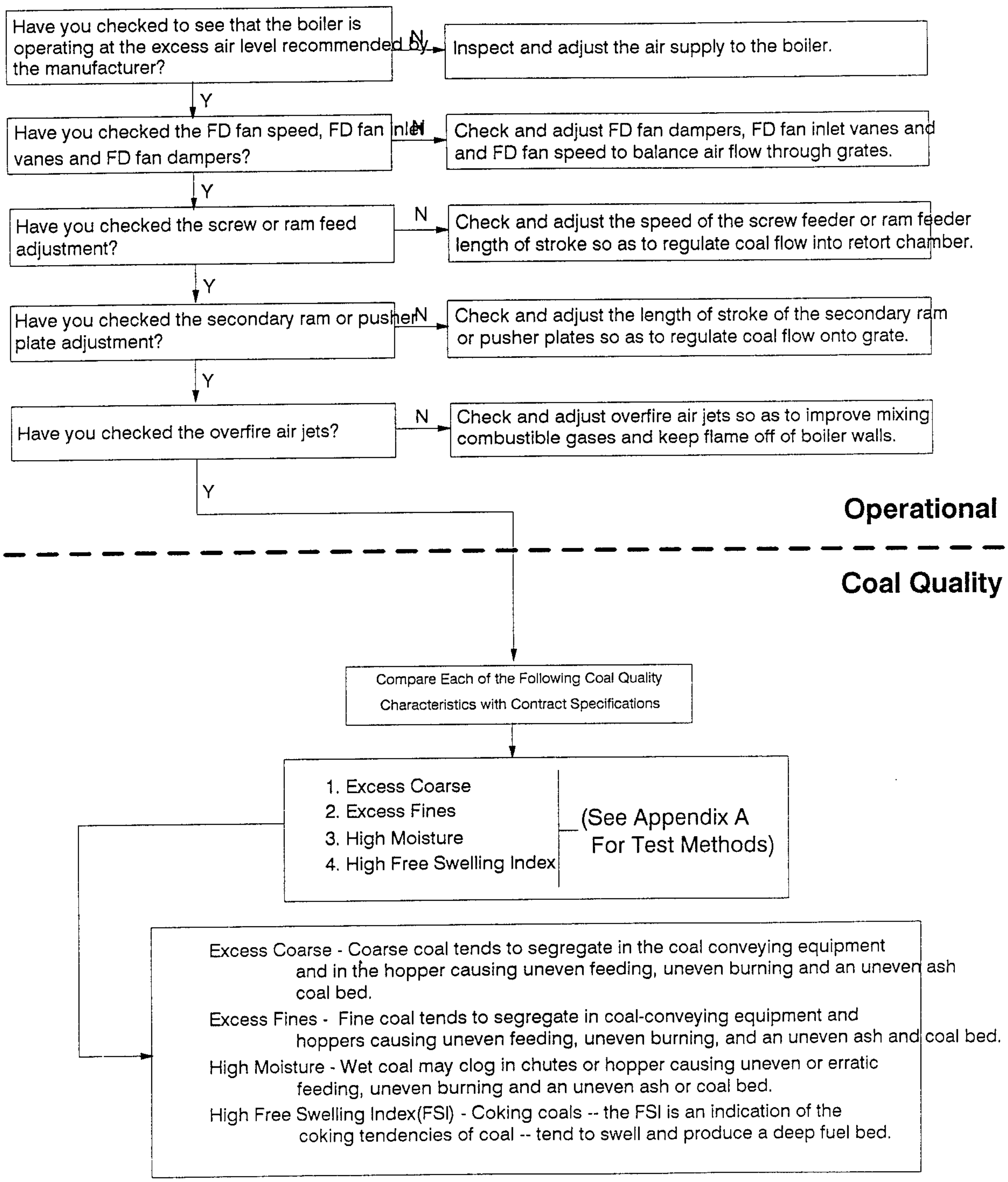


FIG3-61n/2

FIGURE 3-62: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Warped, Burnt, Cracked Grates

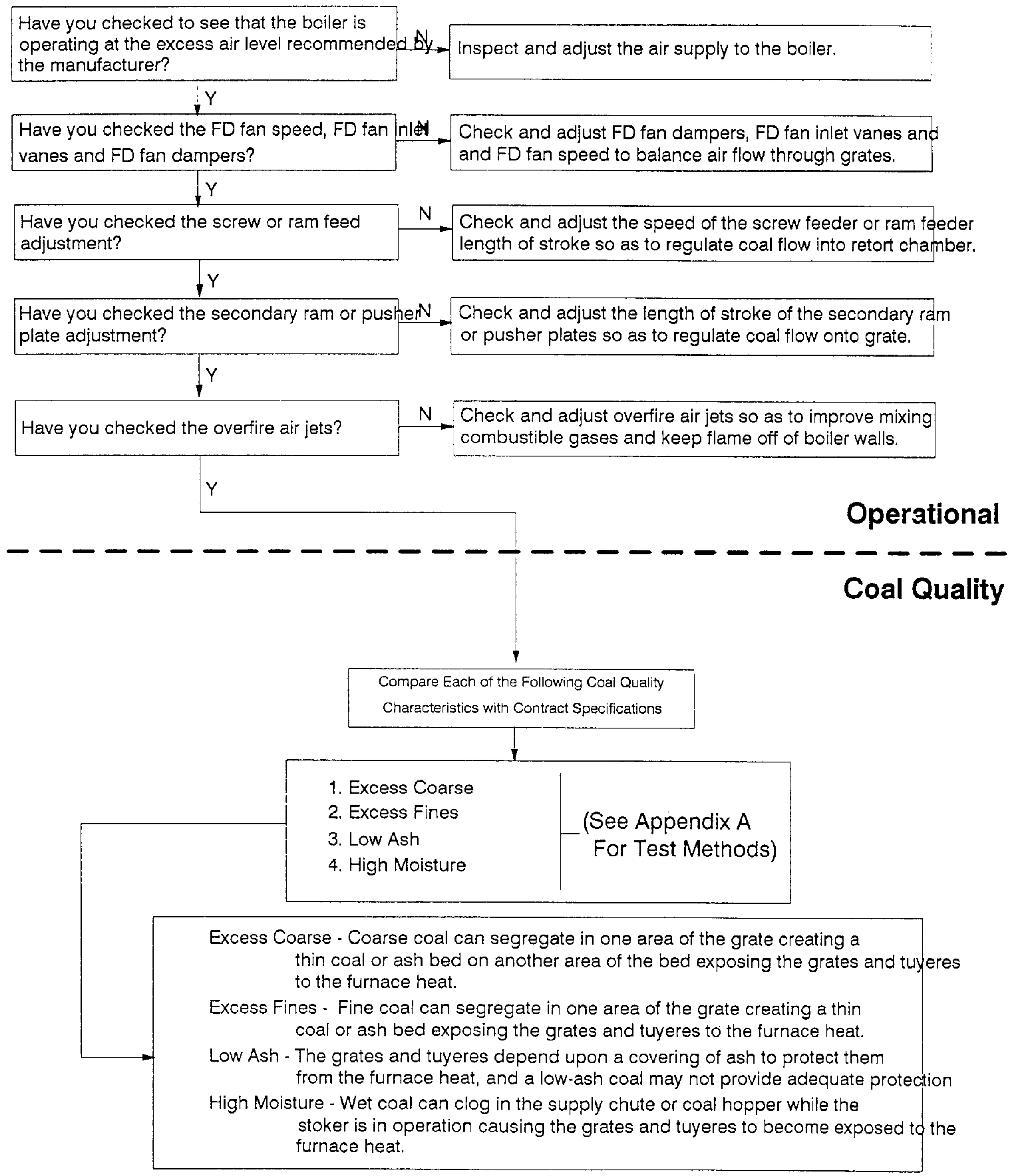


FIG3-62n/2

FIGURE 3-63: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers On The Grate

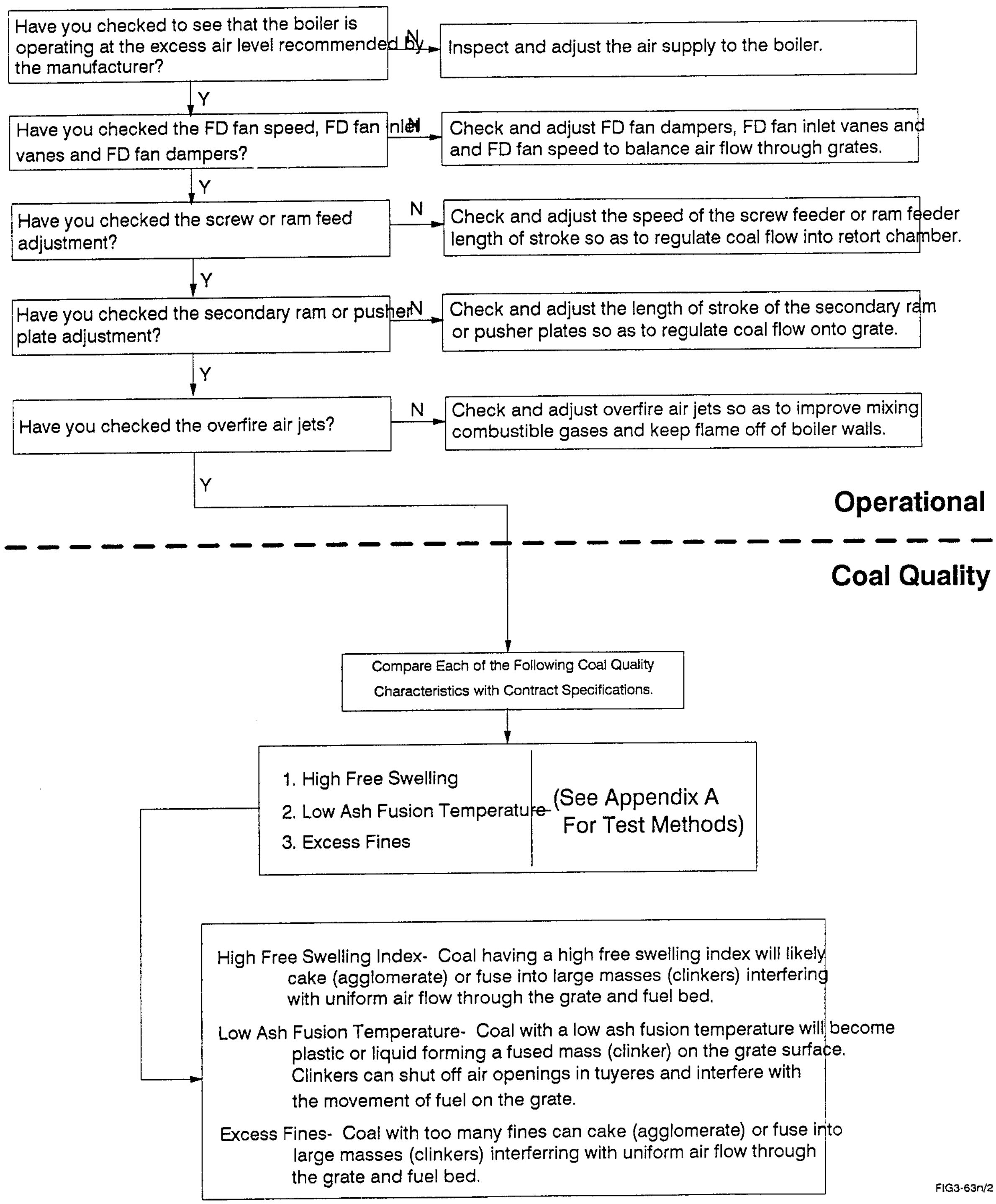


FIG3-63n/2

FIGURE 3-64: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout On The Grate

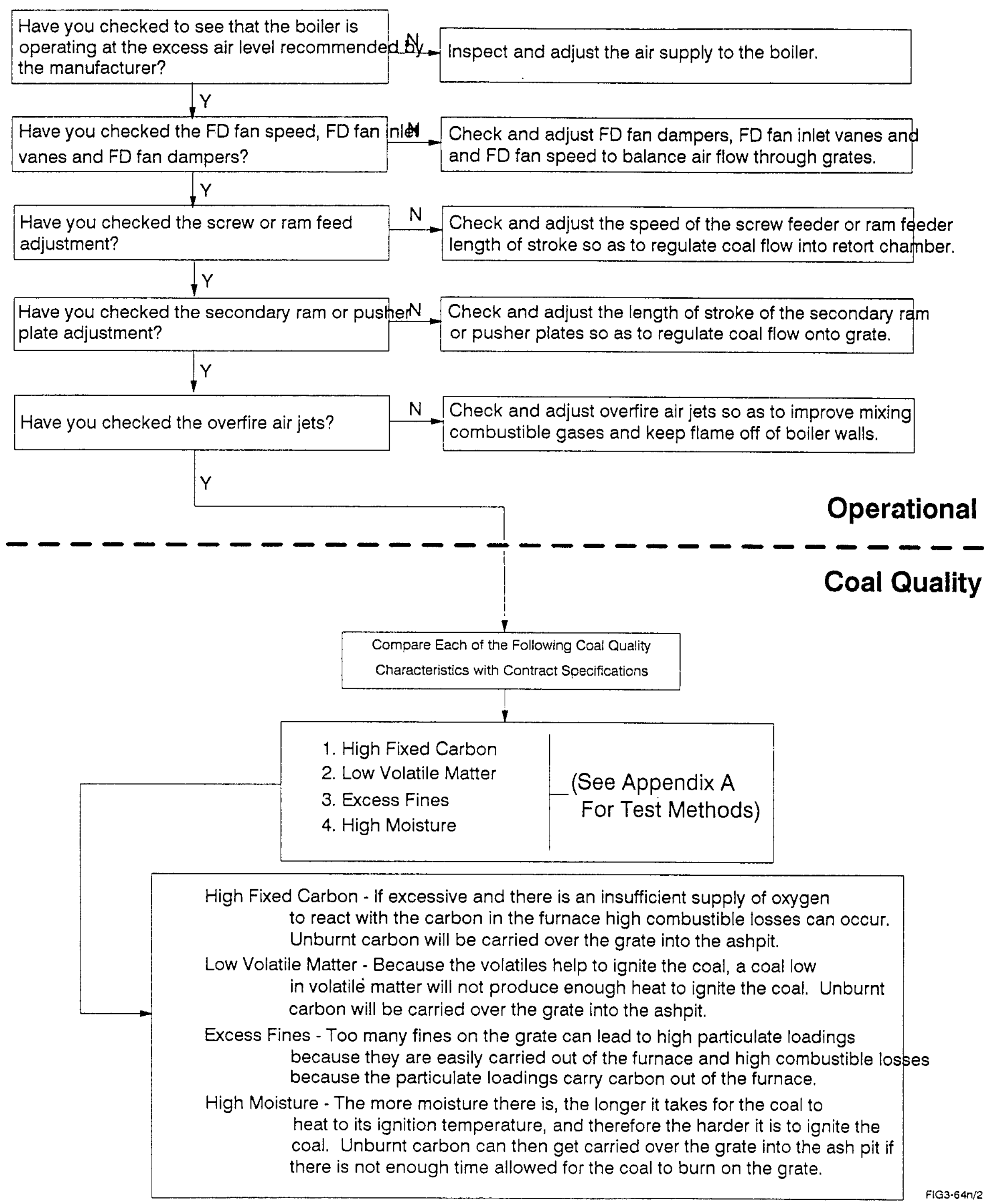


FIGURE 3-65: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of Heat Transfer Surfaces (Refractory Surfaces)

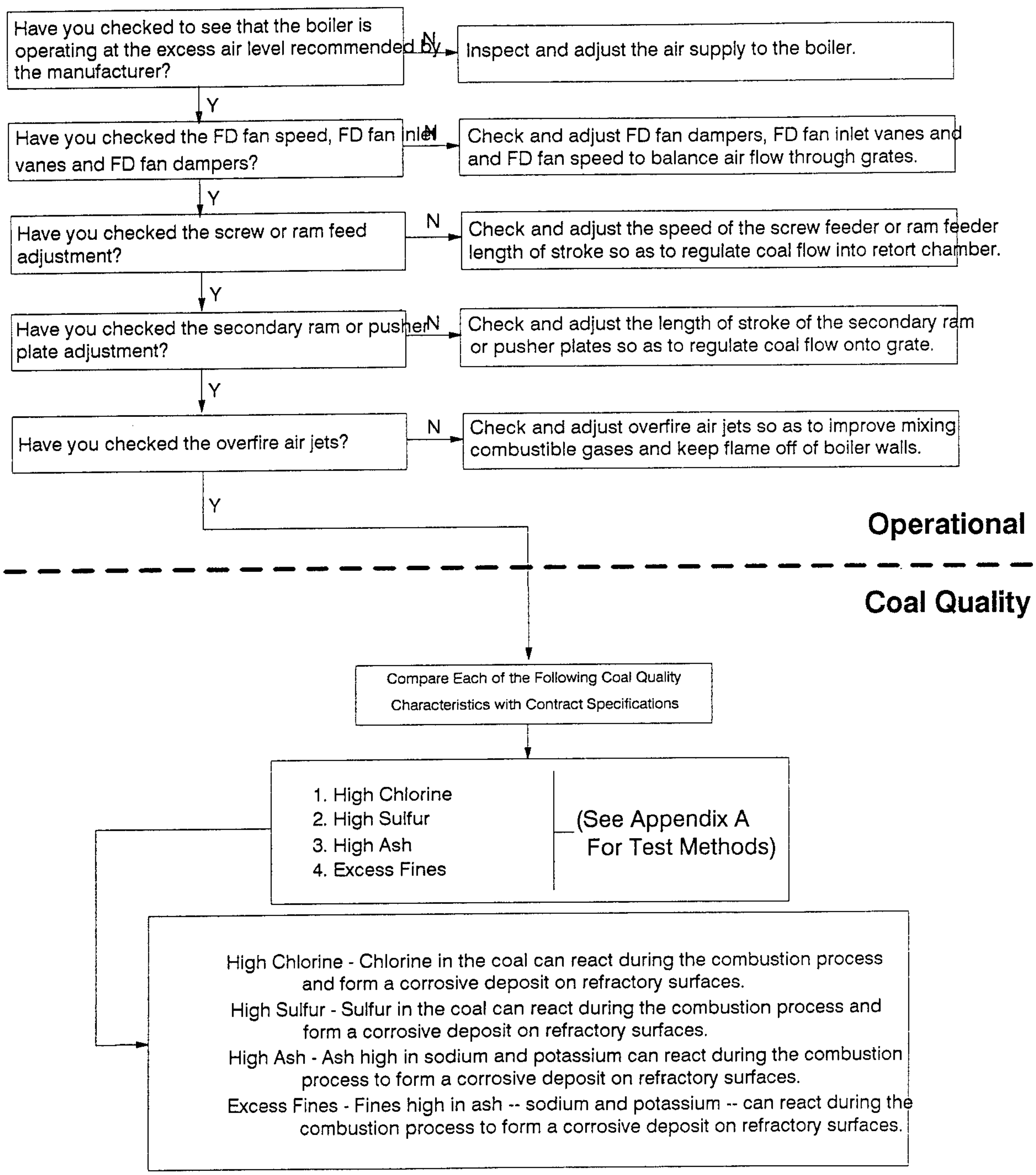
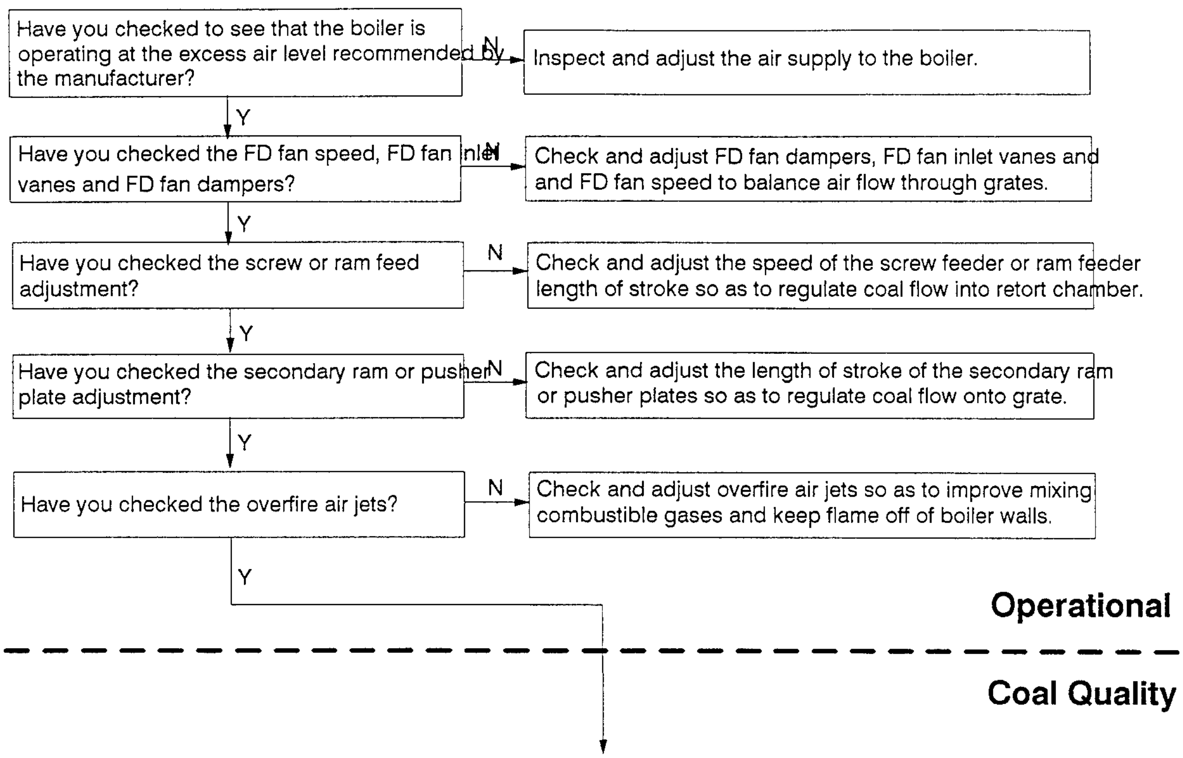


FIG3-65n/2

FIGURE 3-66: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Refractory Surfaces)



See next page for Coal Quality Section.

FIG3-66n/2

IGURE 3-66 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Refractory Surfaces)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on refractory surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away the surface.

FIG3-66nb/2

FIGURE 3-67: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Heat Transfer Surfaces
(Refractory Surfaces)

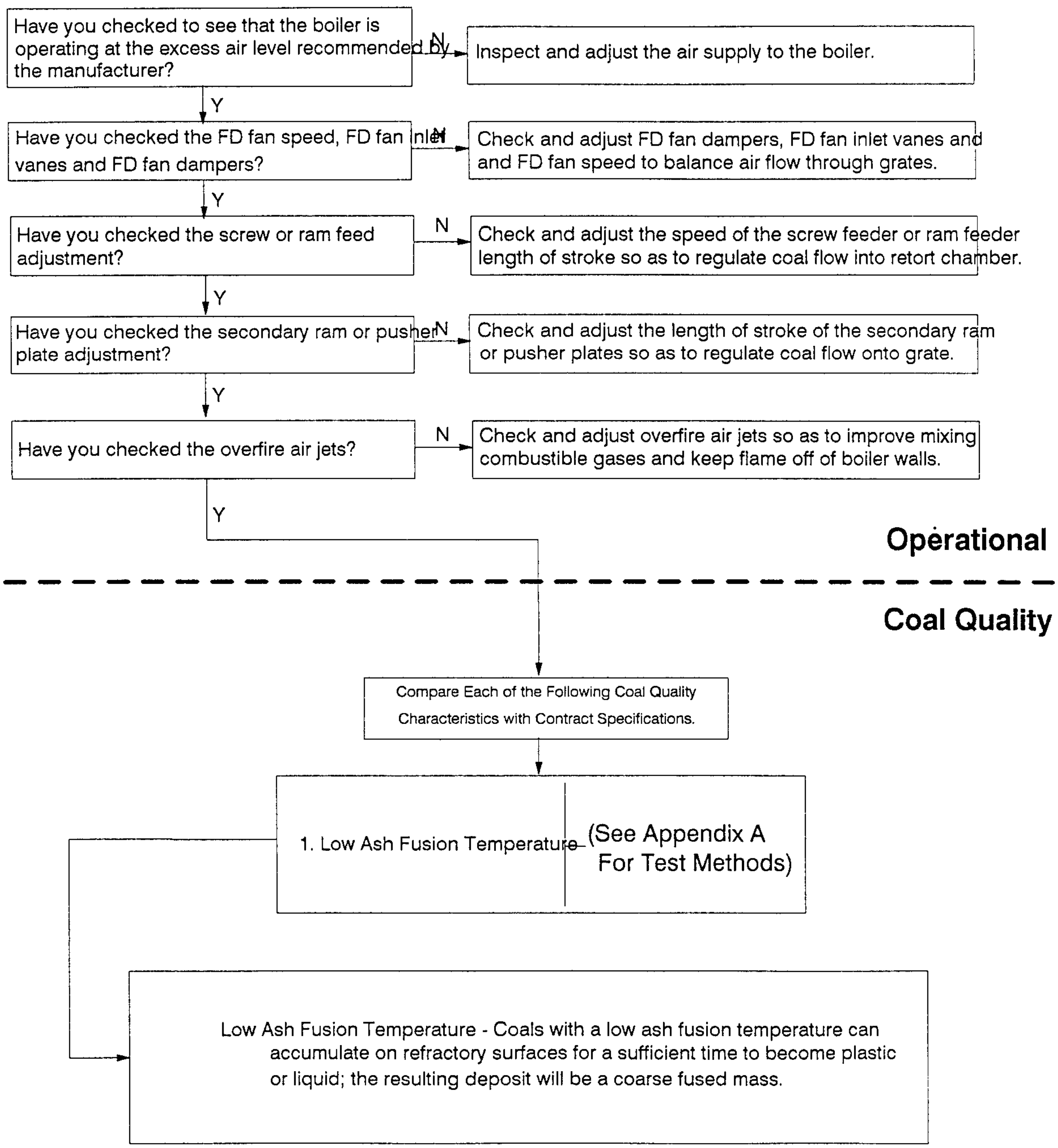


FIG3-67n/2

FIGURE 3-68: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

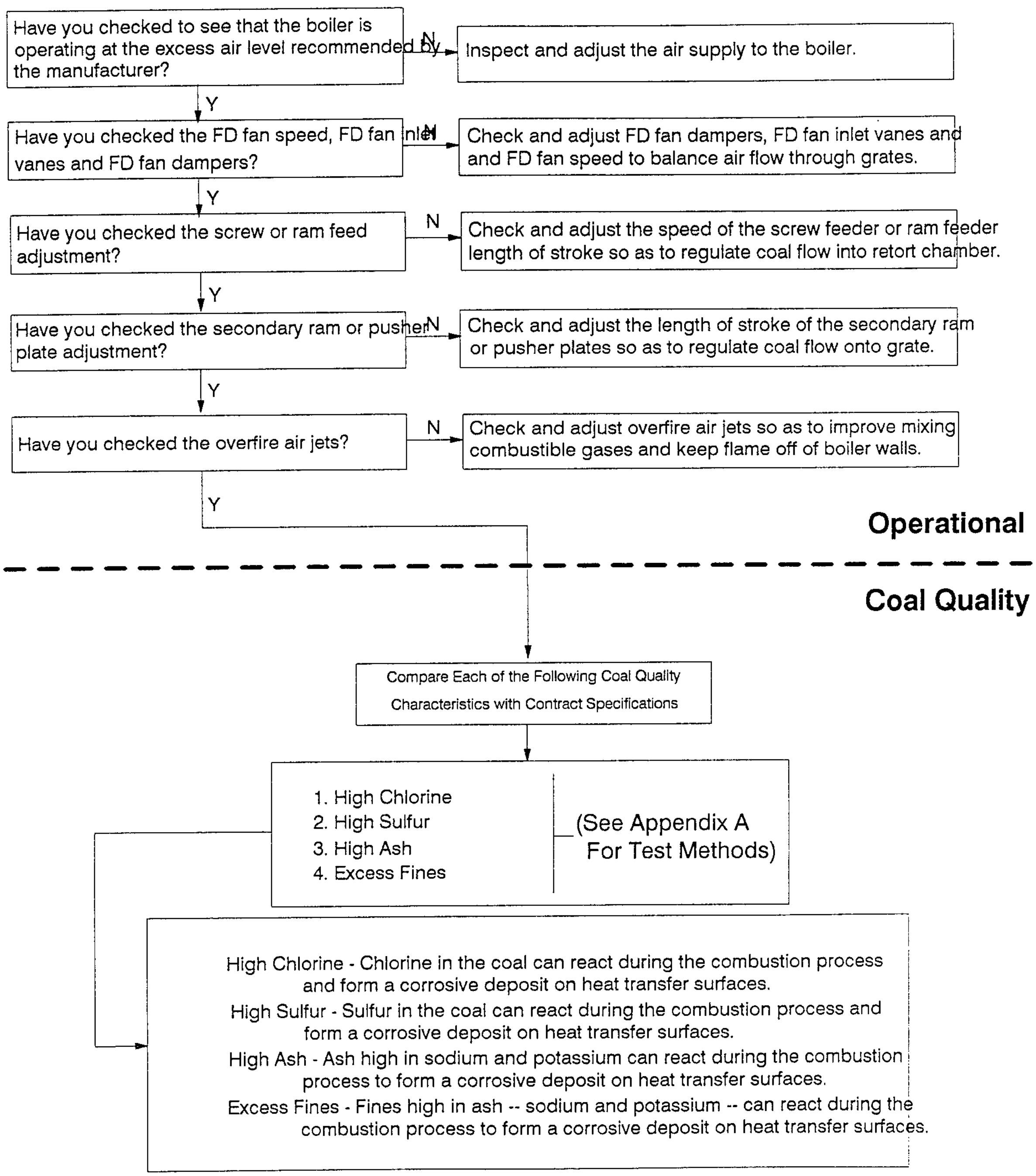
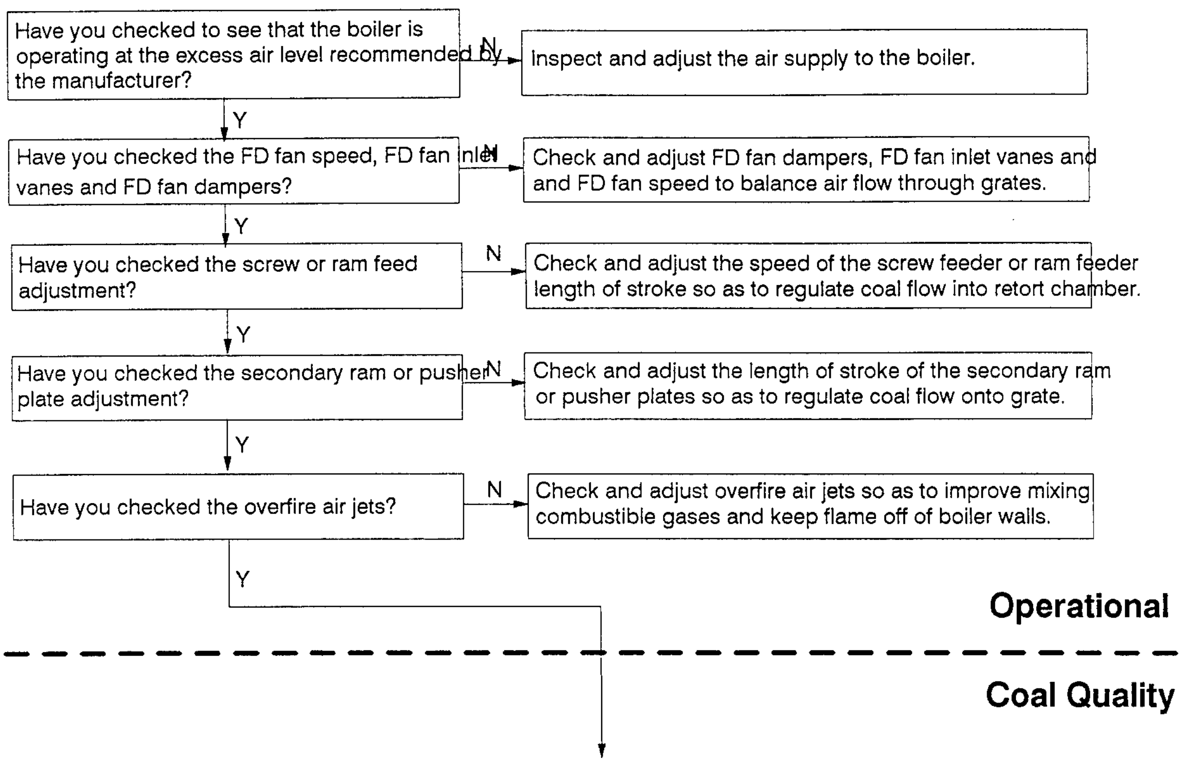


FIG3-68n/2

FIGURE 3-69: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)



See next page for Coal Quality Section.

FIG3-69n/2

FIGURE 3-69 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on heat transfer surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away the surface.

FIGS-69no/2

FIGURE 3-70: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

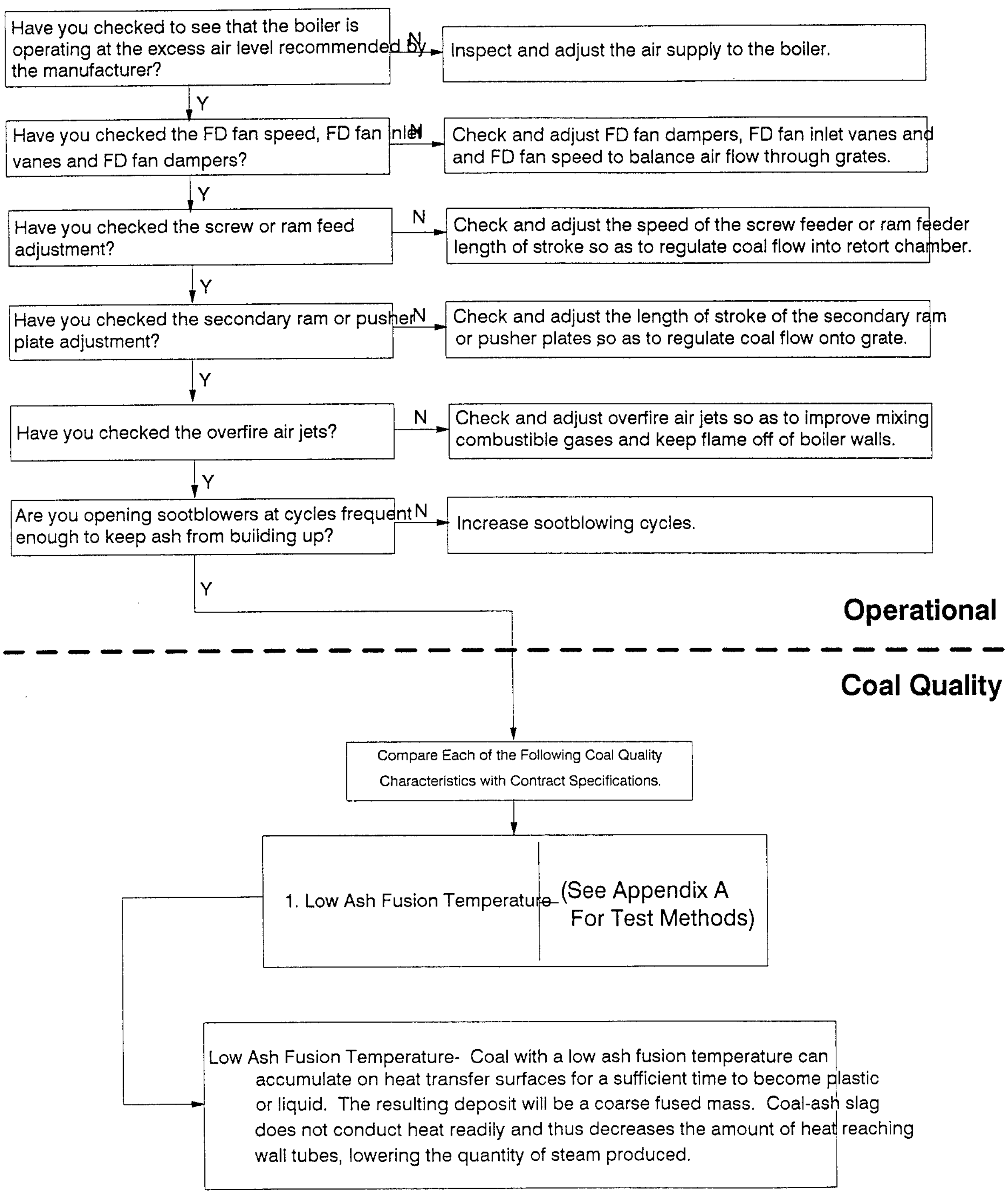


FIG3-70n/2

FIGURE 3-71: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

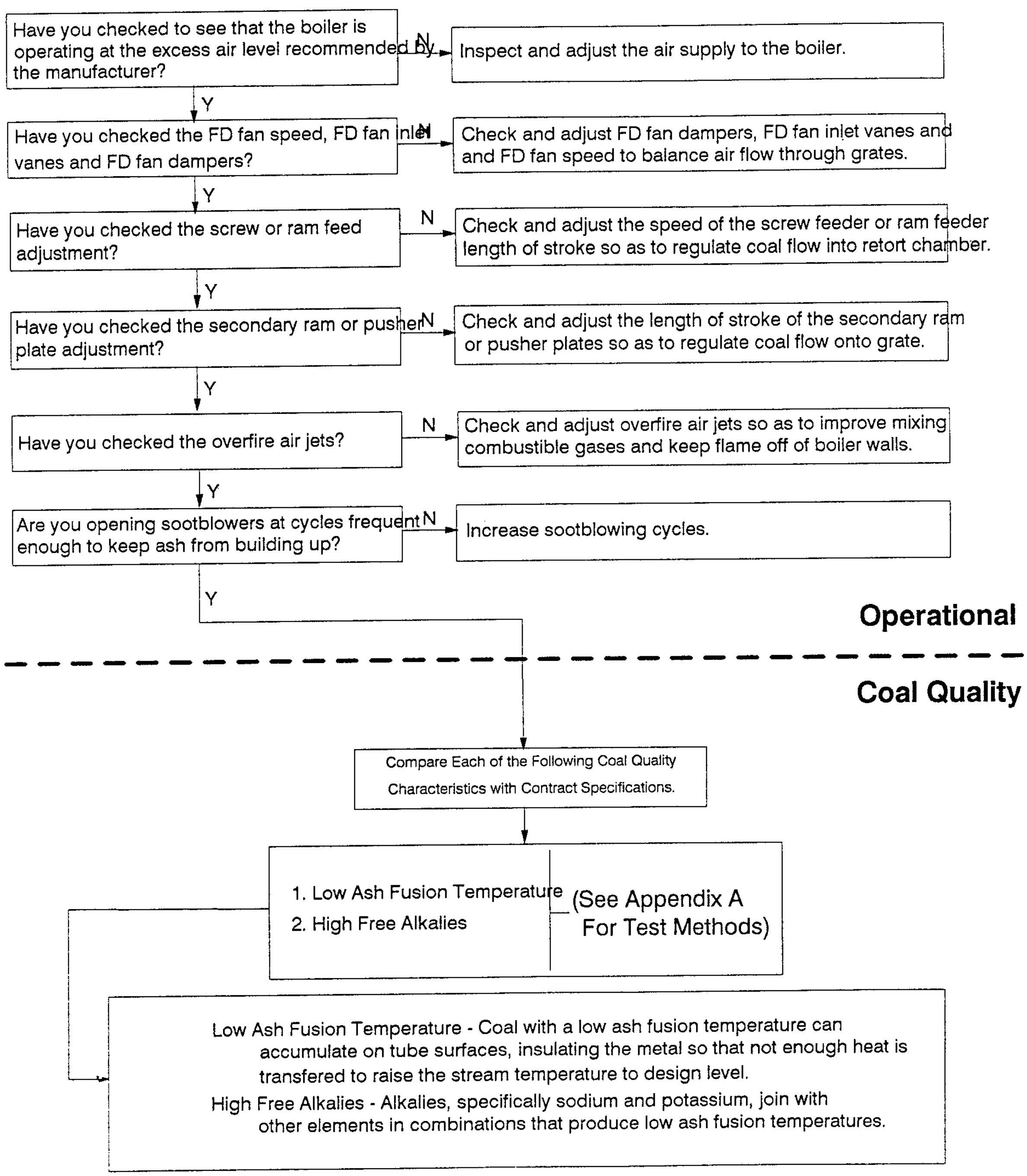


FIG3-71n/3

FIGURE 3-72: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of Heat Transfer Surfaces
(Baffles)

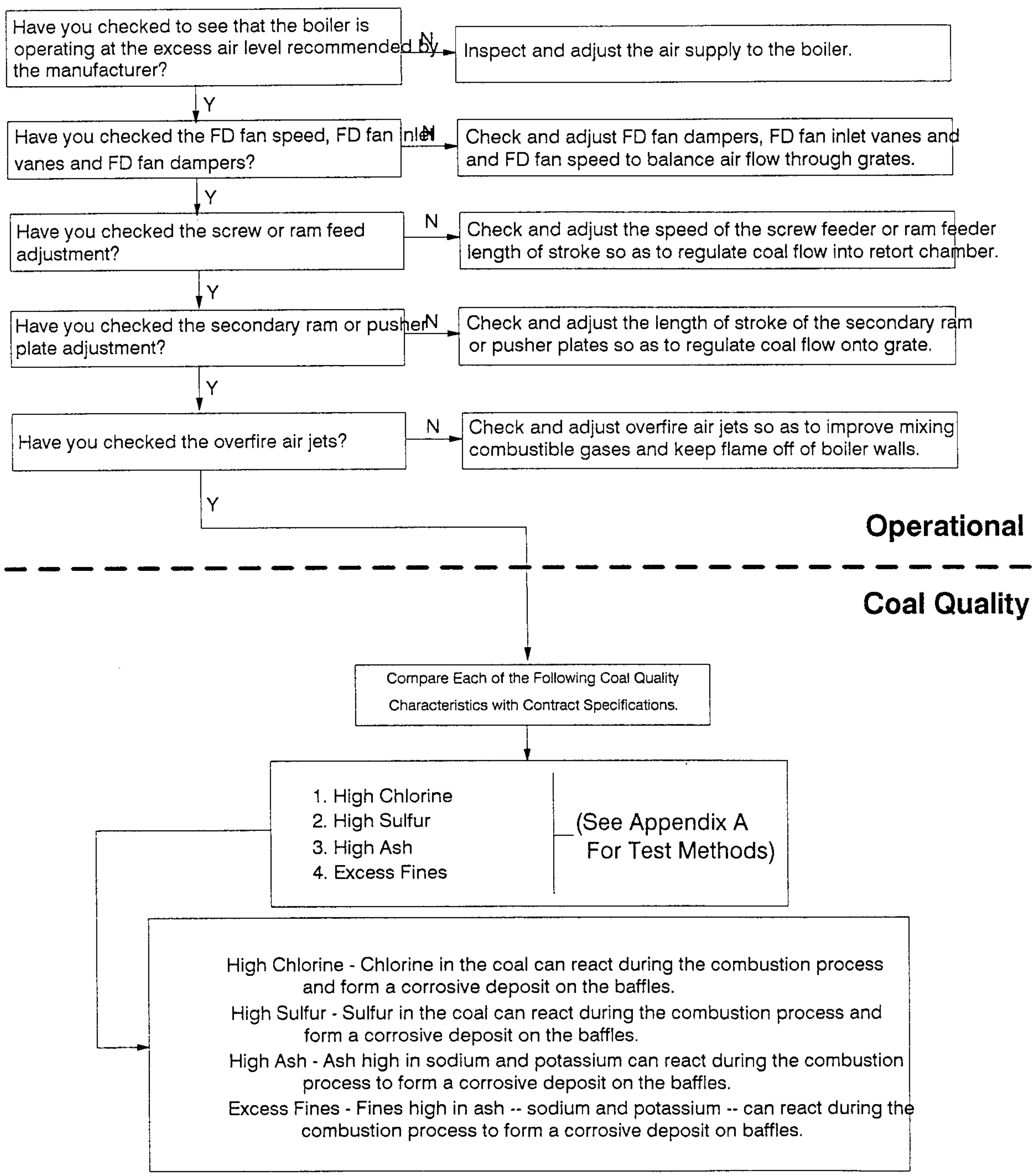


FIG3-72n/3

FIGURE 3-73: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces (Baffles)

Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer?
N → Inspect and adjust the air supply to the boiler.
Y ↓

Have you checked the FD fan speed, FD fan inlet vanes and FD fan dampers?
N → Check and adjust FD fan dampers, FD fan inlet vanes and and FD fan speed to balance air flow through grates.
Y ↓

Have you checked the screw or ram feed adjustment?
N → Check and adjust the speed of the screw feeder or ram feeder length of stroke so as to regulate coal flow into retort chamber.
Y ↓

Have you checked the secondary ram or pusher plate adjustment?
N → Check and adjust the length of stroke of the secondary ram or pusher plates so as to regulate coal flow onto grate.
Y ↓

Have you checked the overfire air jets?
N → Check and adjust overfire air jets so as to improve mixing combustible gases and keep flame off of boiler walls.
Y ↓

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on baffles eventually wearing away the surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the baffles eventually wearing away the surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

FIG3-73n/3

FIGURE 3-74: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Heat Transfer Surfaces (Baffles)

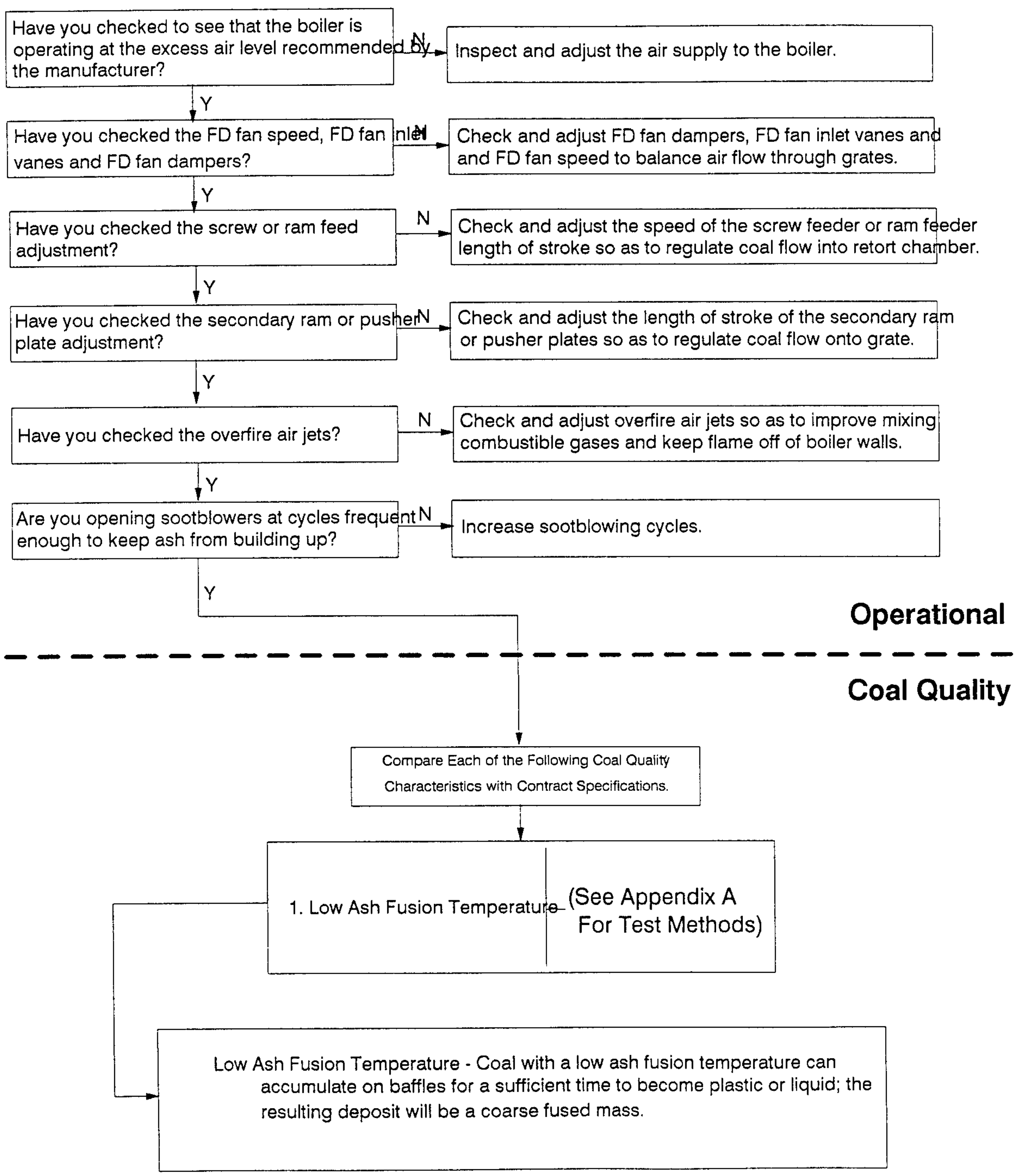


FIG3-74n/3

FIGURE 3-75: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Baffles)

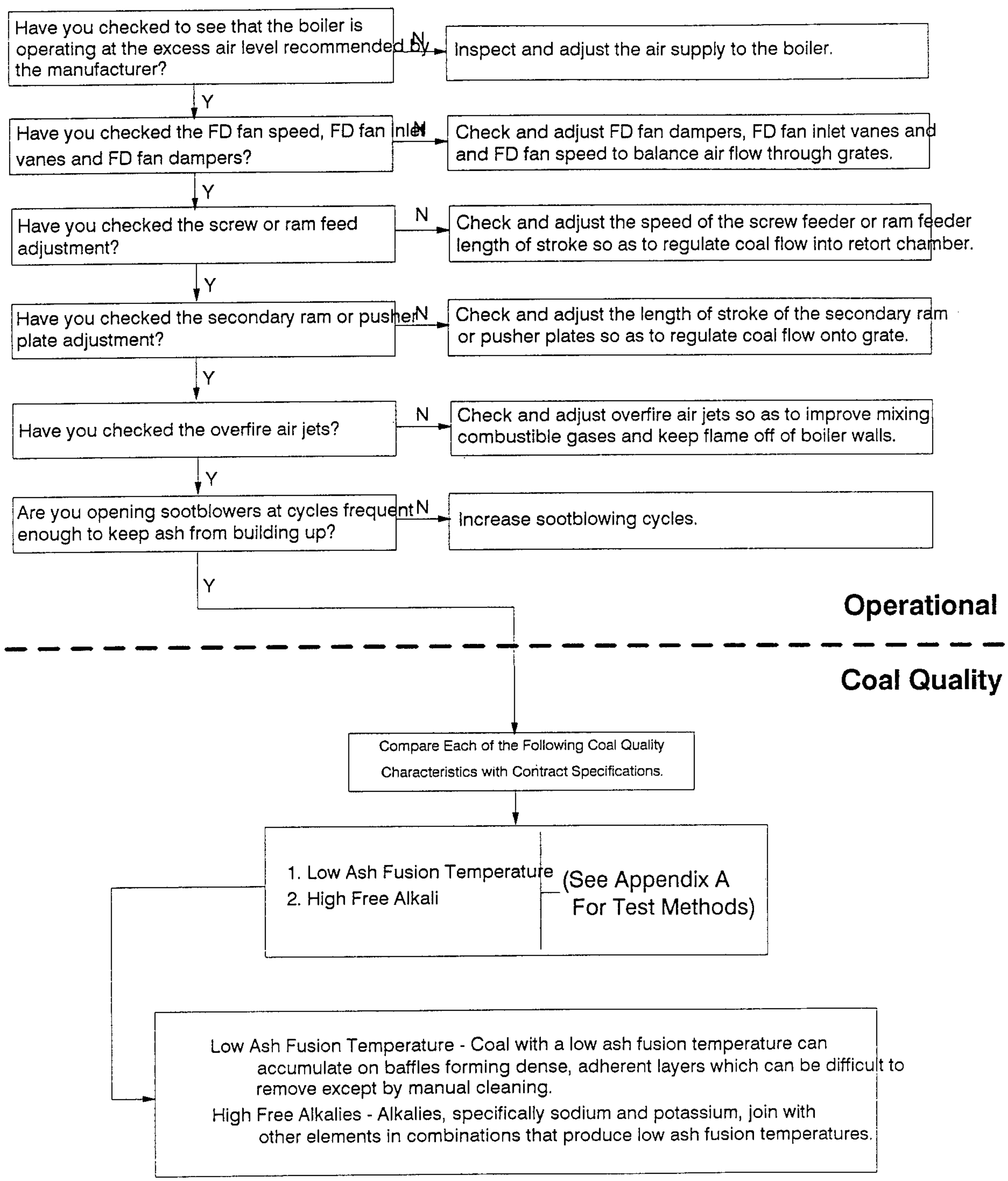


FIG3-75n/3

FIGURE 3-76: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity and Inability To Meet Load
(Forced Draft Fan)

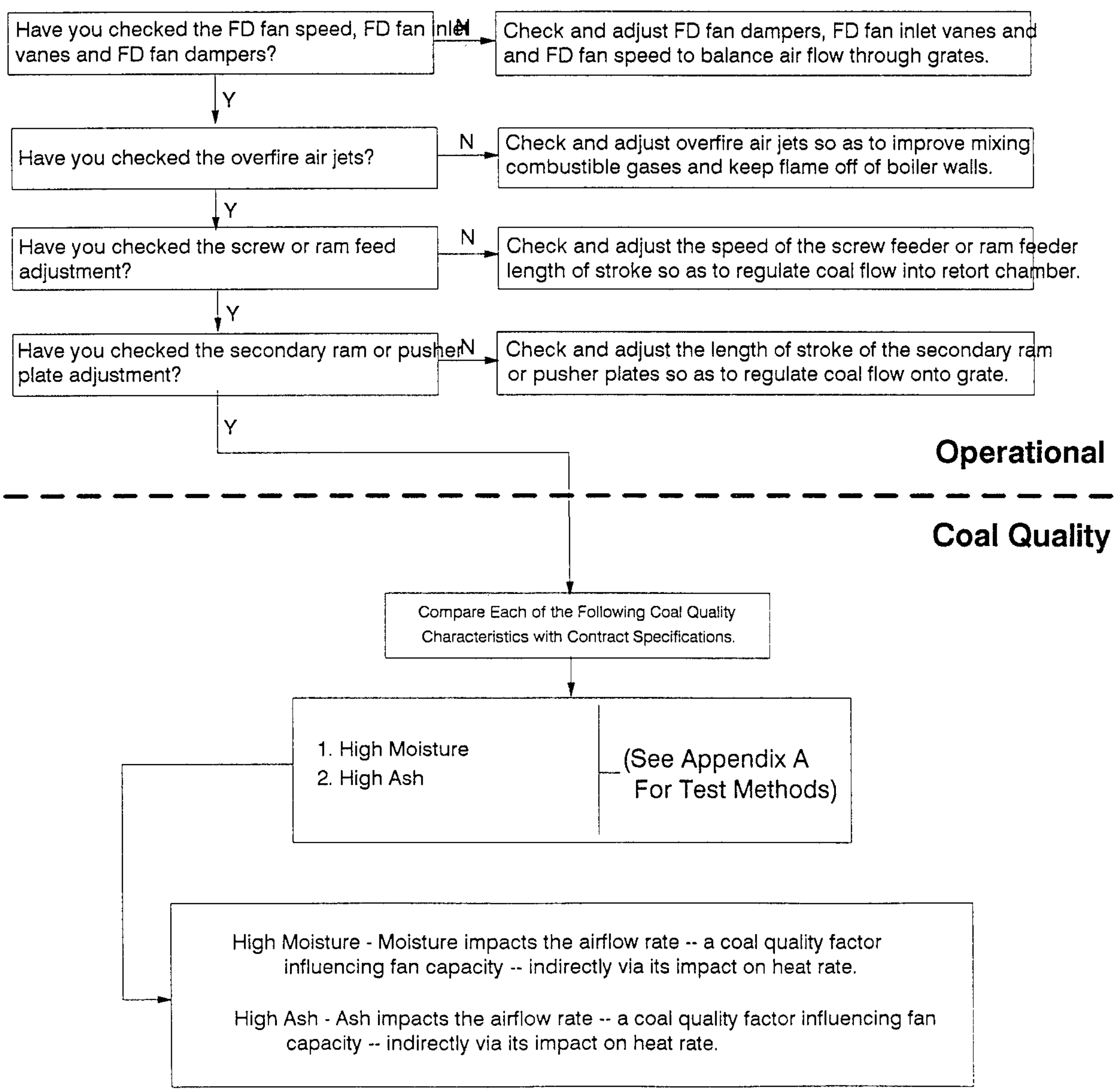


FIG3-76n/3

FIGURE 3-77: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Forced Draft Fan

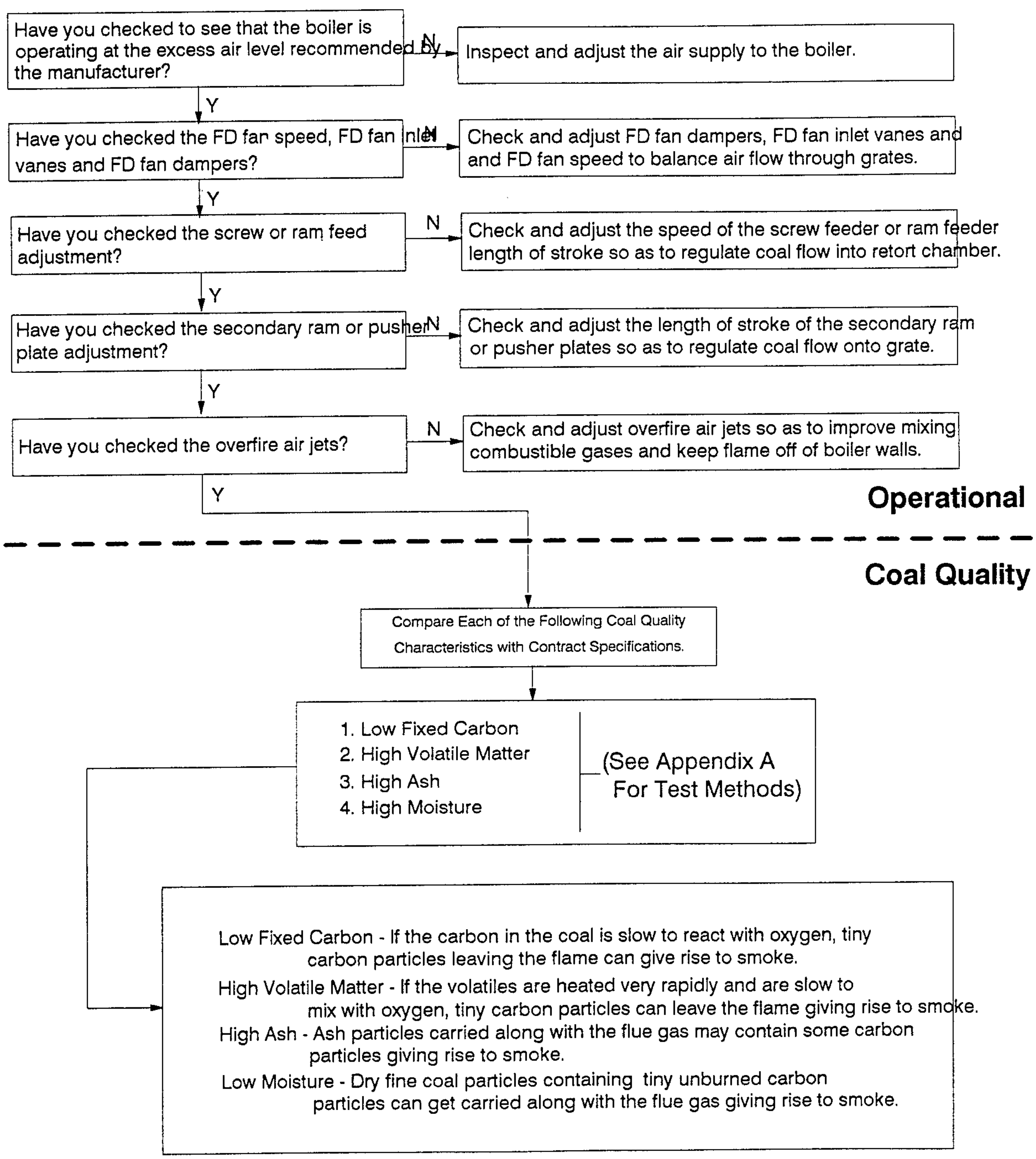


FIG3-77n/3

FIGURE 3-78: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Induced Draft Fan)

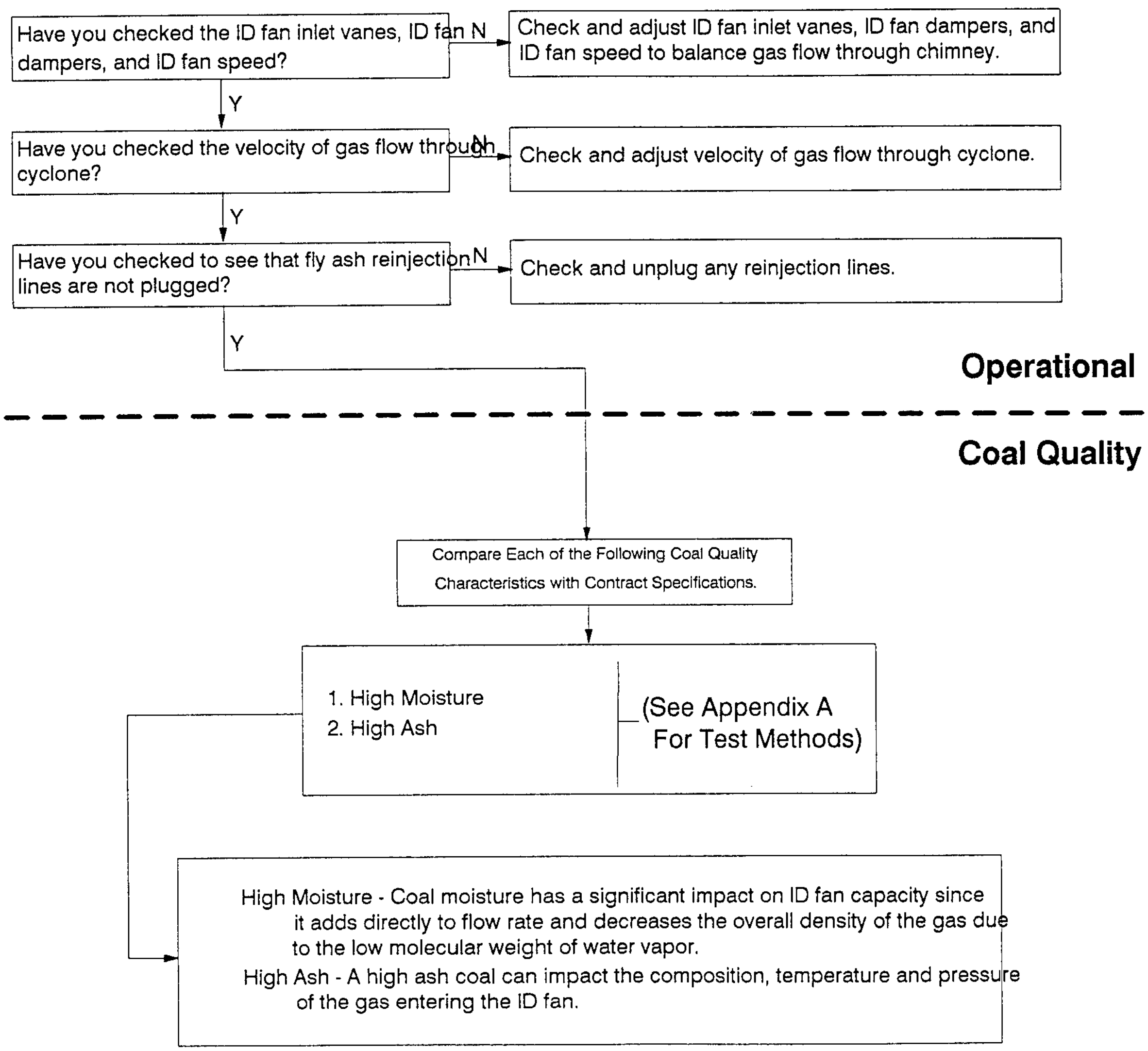


FIG3-78n/3

FIGURE 3-79: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Induced Draft Fan

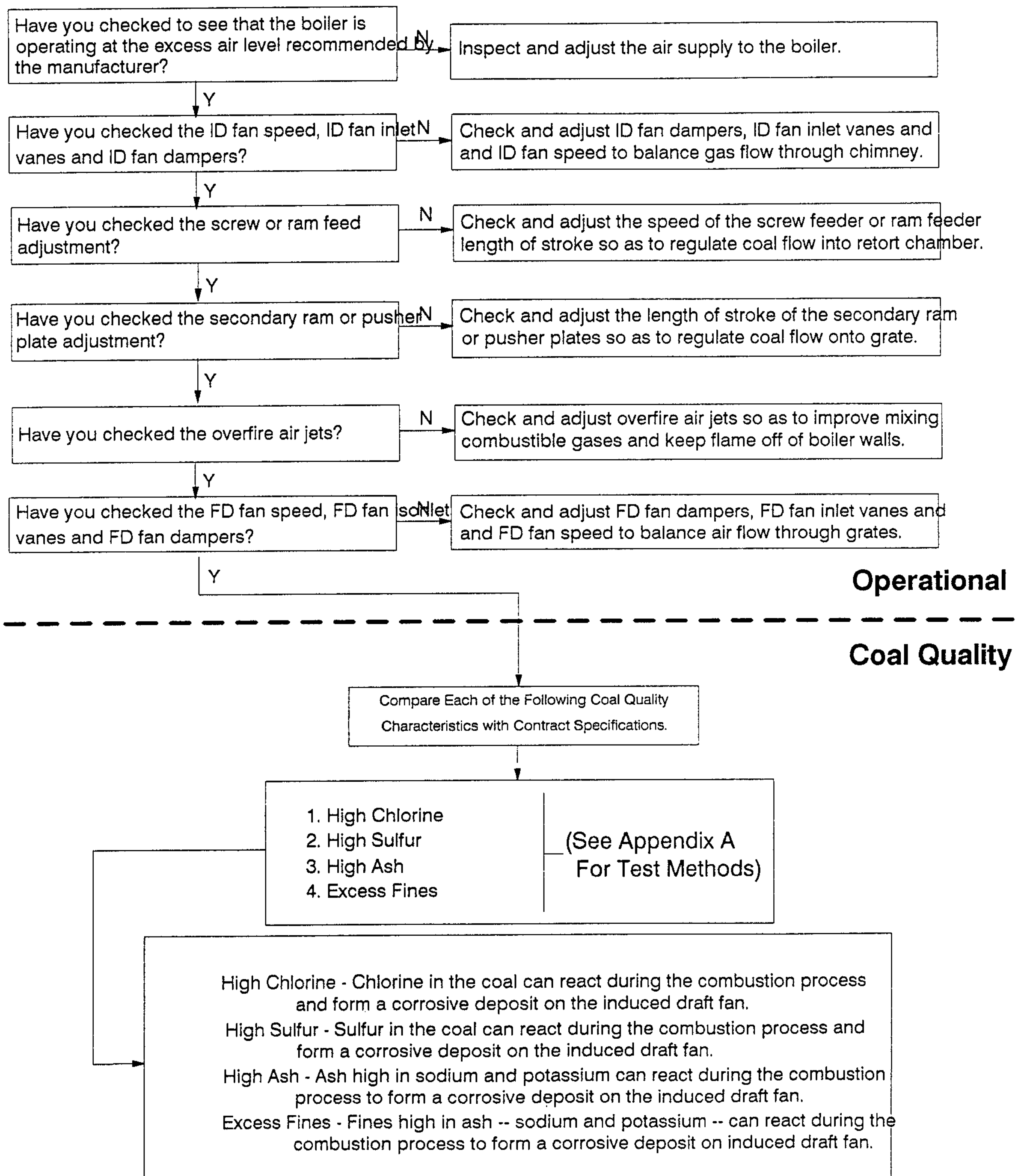
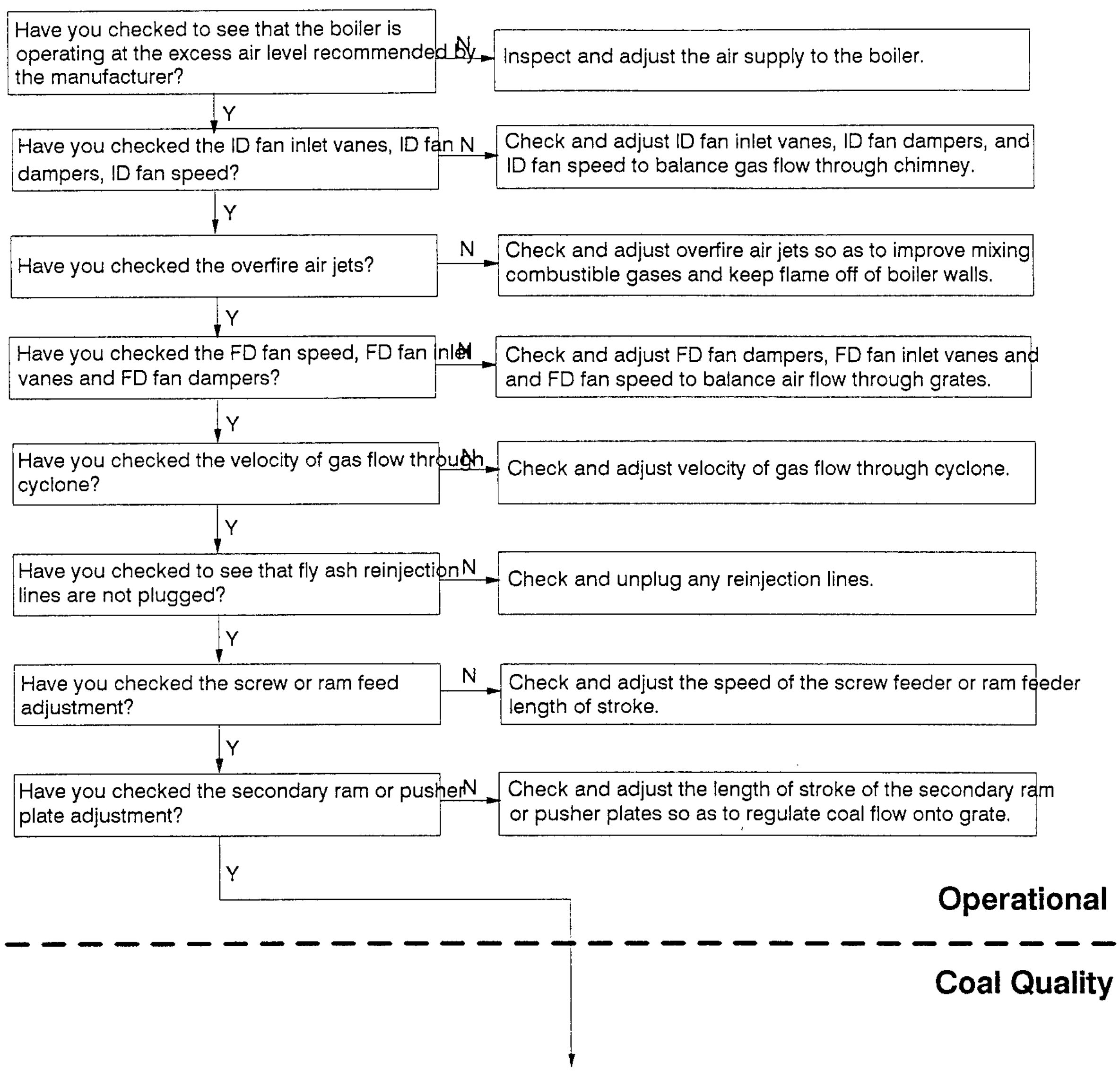


FIG3-77n/3

FIGURE 3-80: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan



See next page for Coal Quality Section

FIG3-80n/3

IGURE 3-80 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

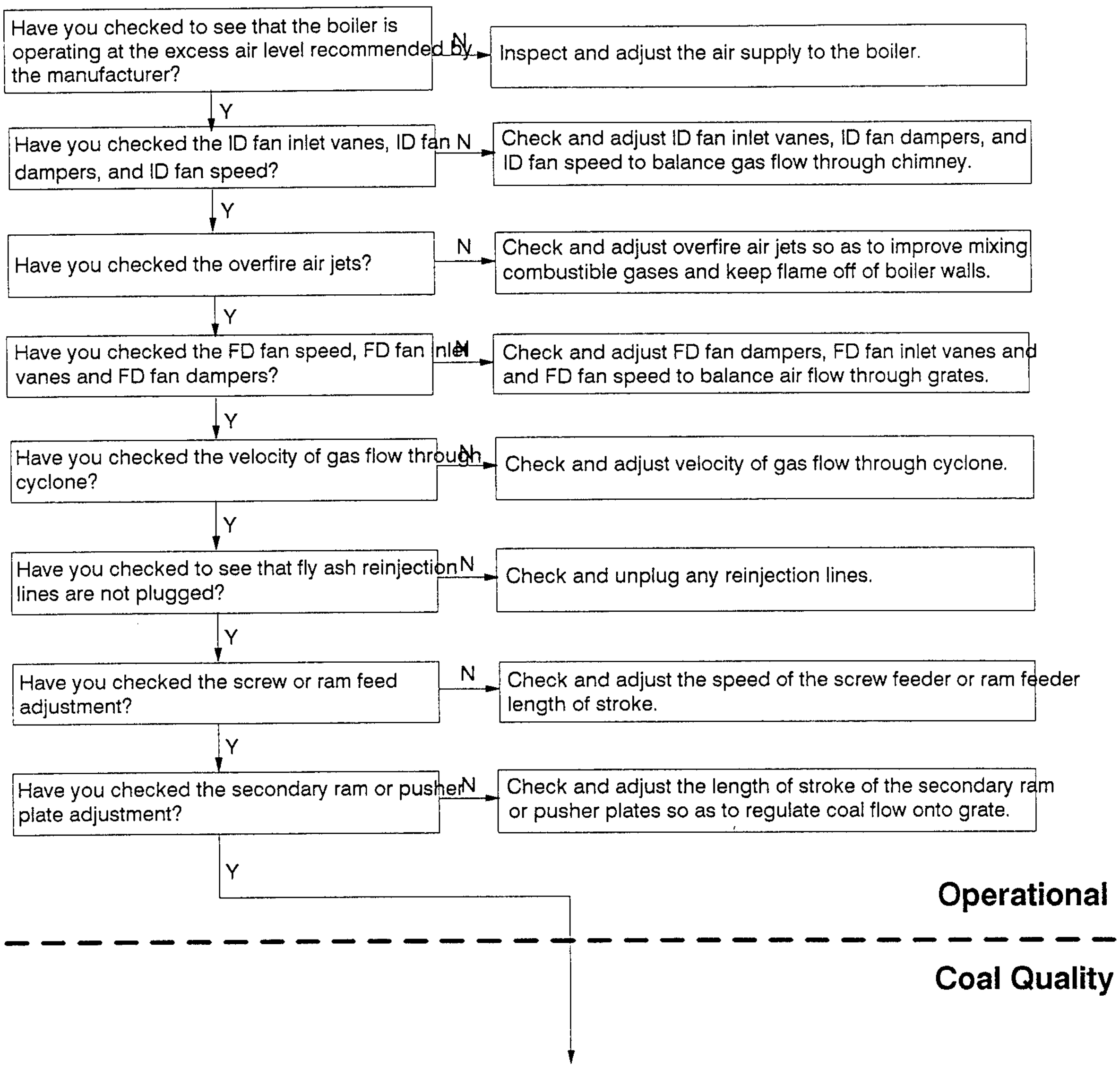
High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG3-80nb/3

FIGURE 3-81: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Induced Draft Fan



See next page for Coal Quality Section

FIG3-81n/3

IGURE 3-81 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAI
For Erosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

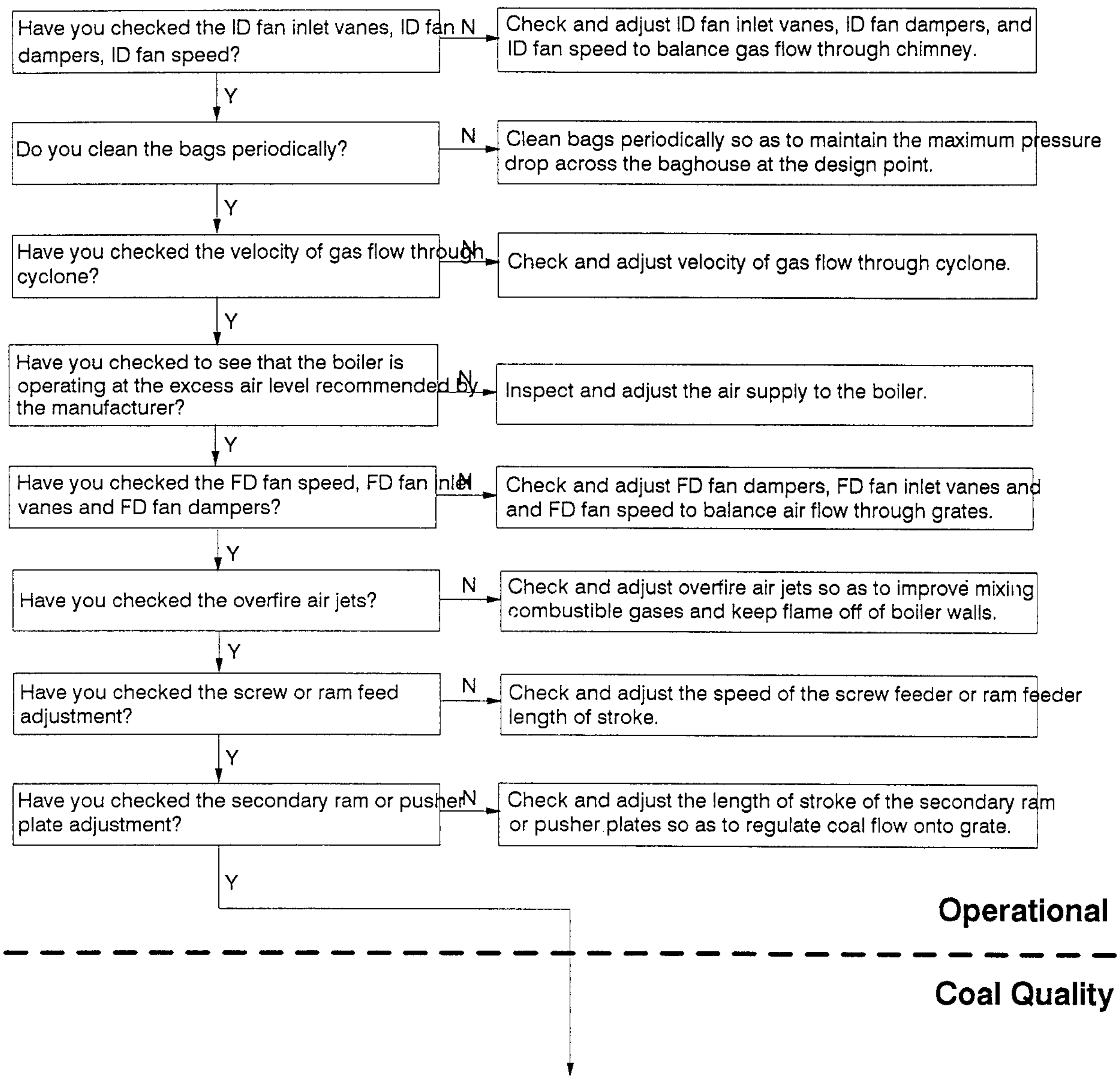
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG3-81nb/3

FIGURE 3-82: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Baghouse)



See next page for Coal Quality Section

FIG3-82n/3

IGURE 3-82 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout From The Particulate Removal System
(Baghouse)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

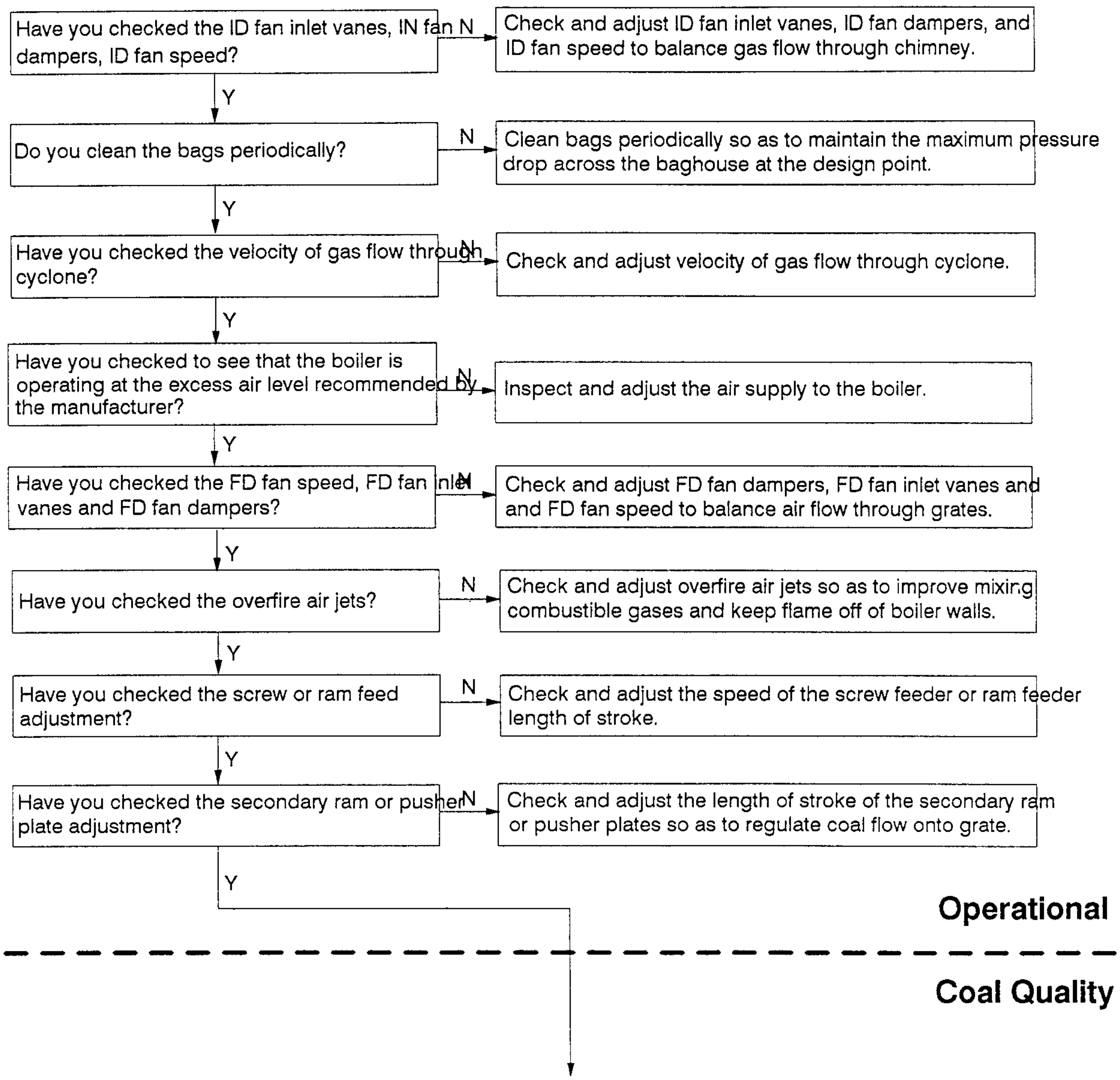
Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG3-82nb/3

FIGURE 3-83: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Baghouse)



See next page for Coal Quality Section

FIG3-83n/3

IGURE 3-83 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRA
For Excess Particulate Emissions From The Particulate Removal System (Baghouse)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the chimney.

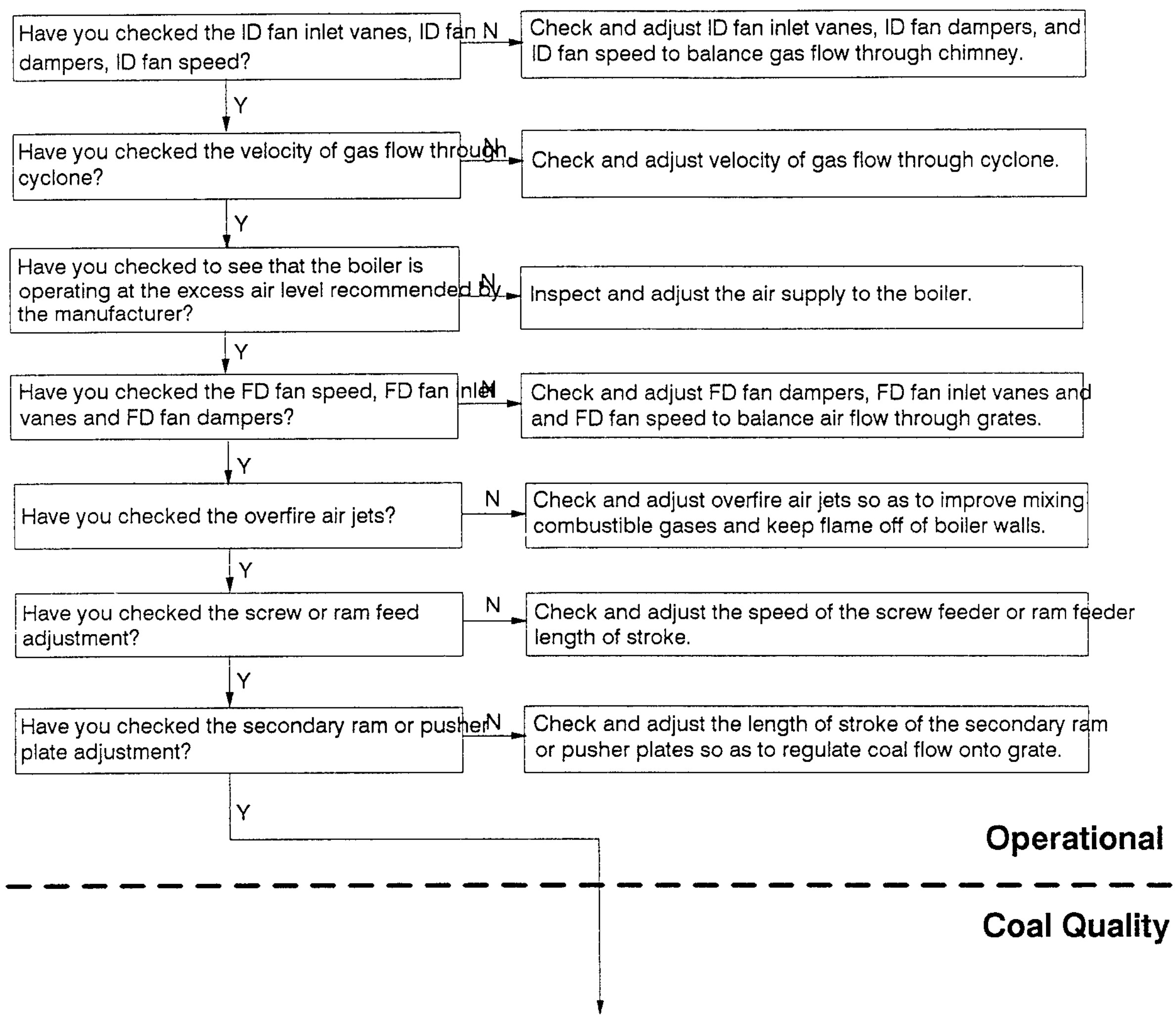
High Ash - Ash can get entrained in the flue gas and get carried out the chimney.

Low Moisture - Dry fine coal particles can become entrained in the flue gas and get carried out the chimney.

FIG3-83nb/3

FIGURE 3-84: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Cyclone)



See next page for Coal Quality Section

FIG3-83n/3

FIGURE 3-84 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGF
For Carbon Burnout From The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

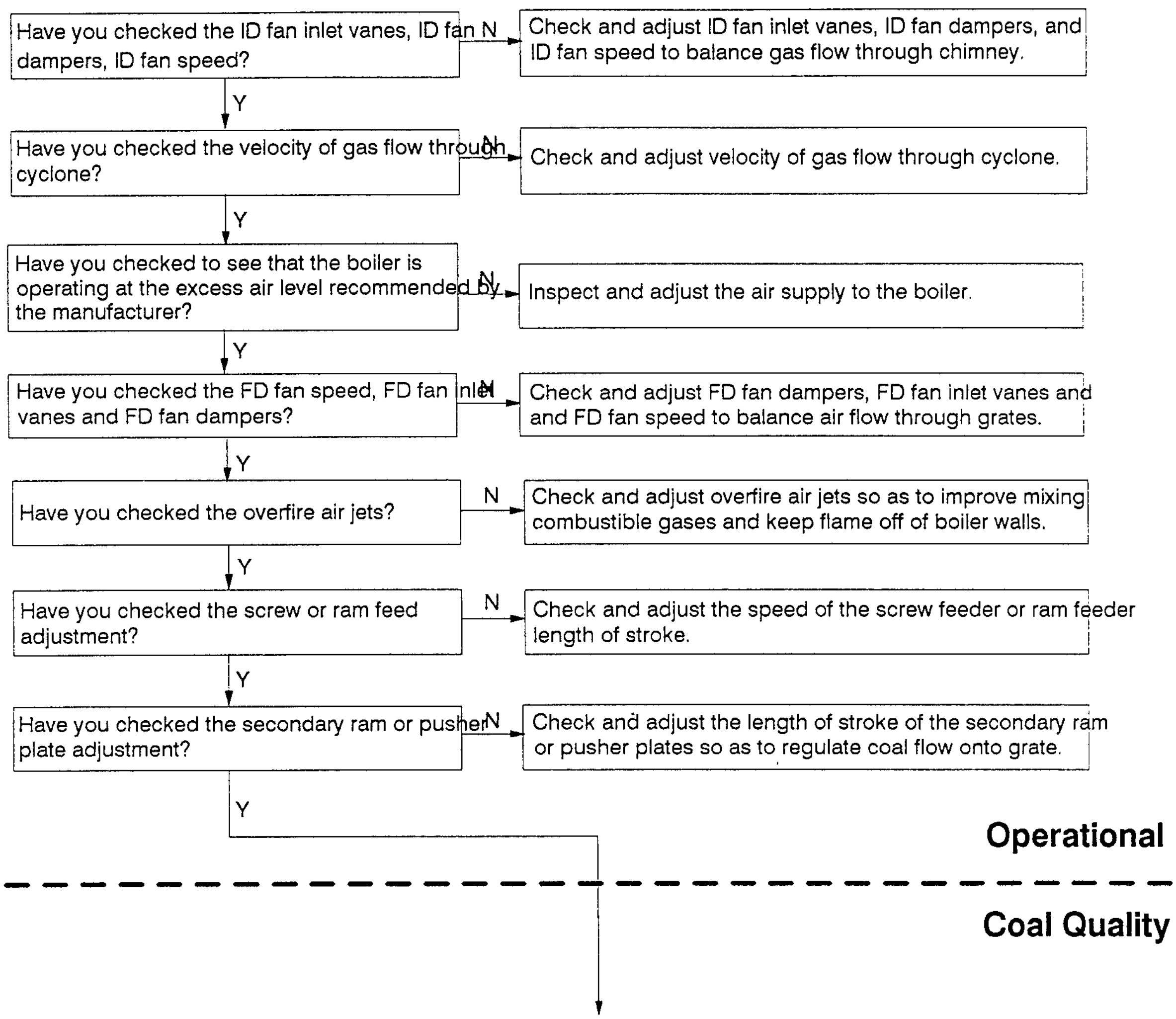
Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG5-84nb/3

FIGURE 3-85: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion In The Particulate Removal System (Cyclone)



See next page for Coal Quality Section

FIG3-85n/3

IGURE 3-85 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion In The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG3-85nb/3

FIGURE 3-86: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Cyclone)

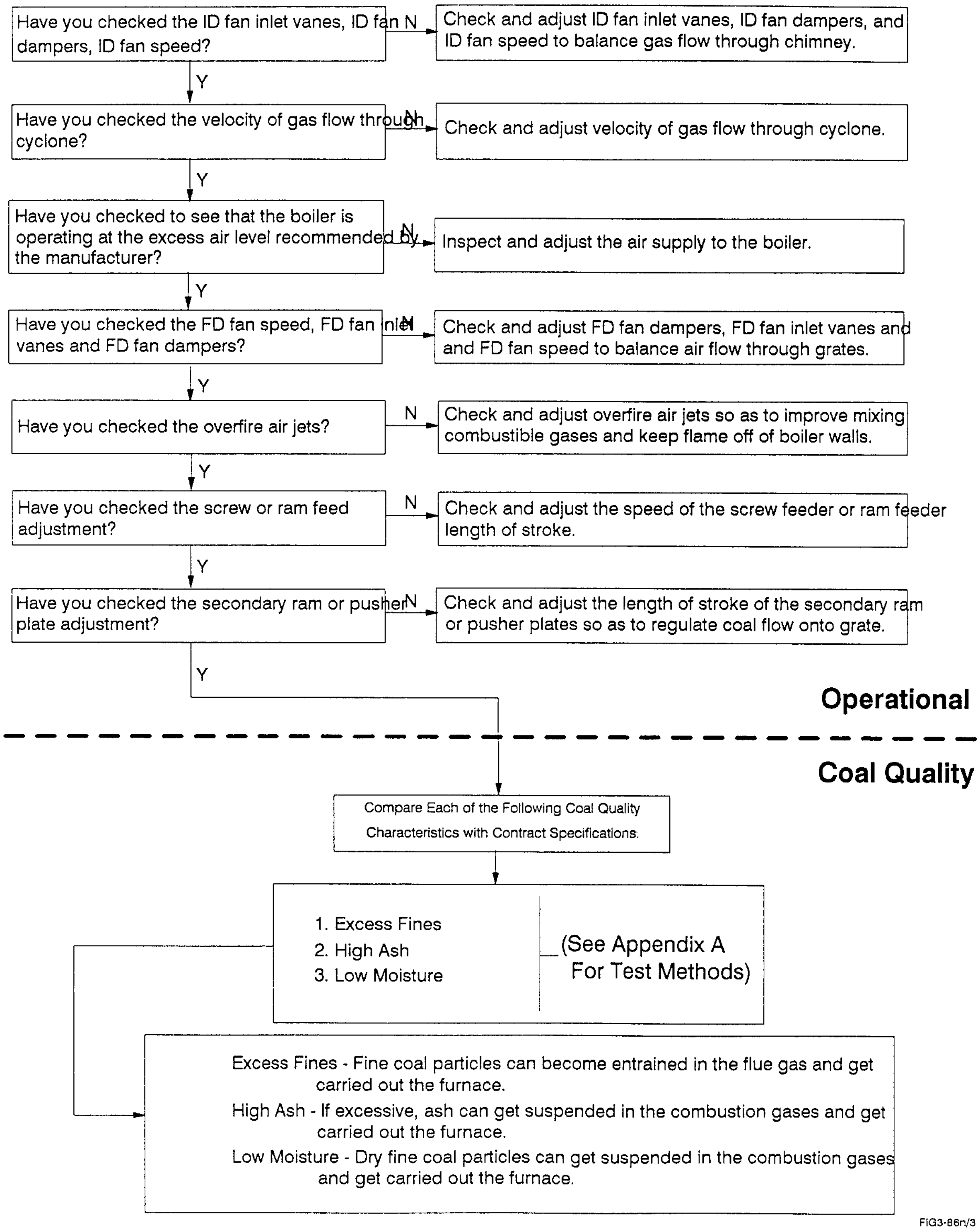
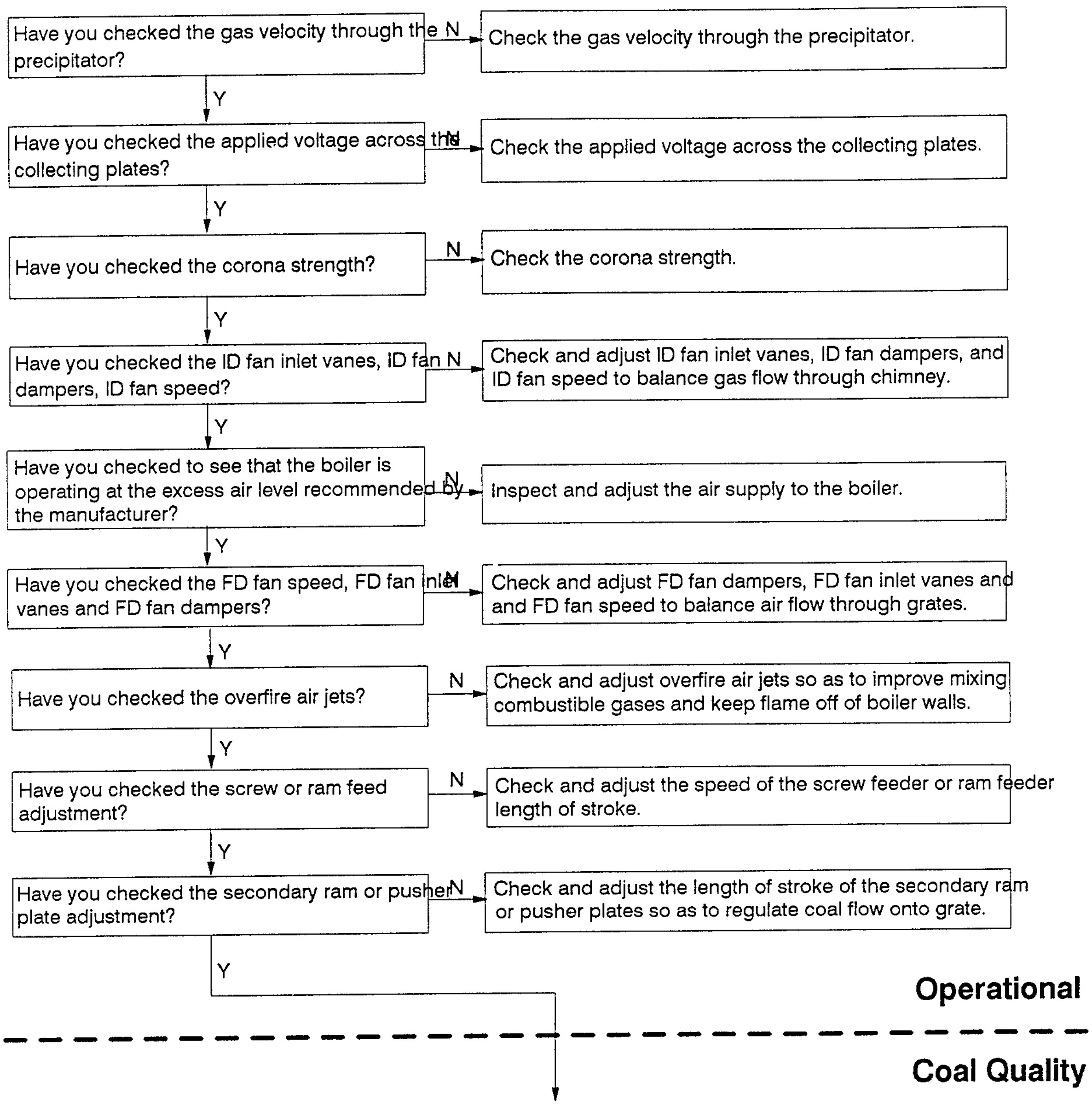


FIGURE 3-87: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG3-87n/3

IGURE 3-87 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAI
For Carbon Burnout From The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

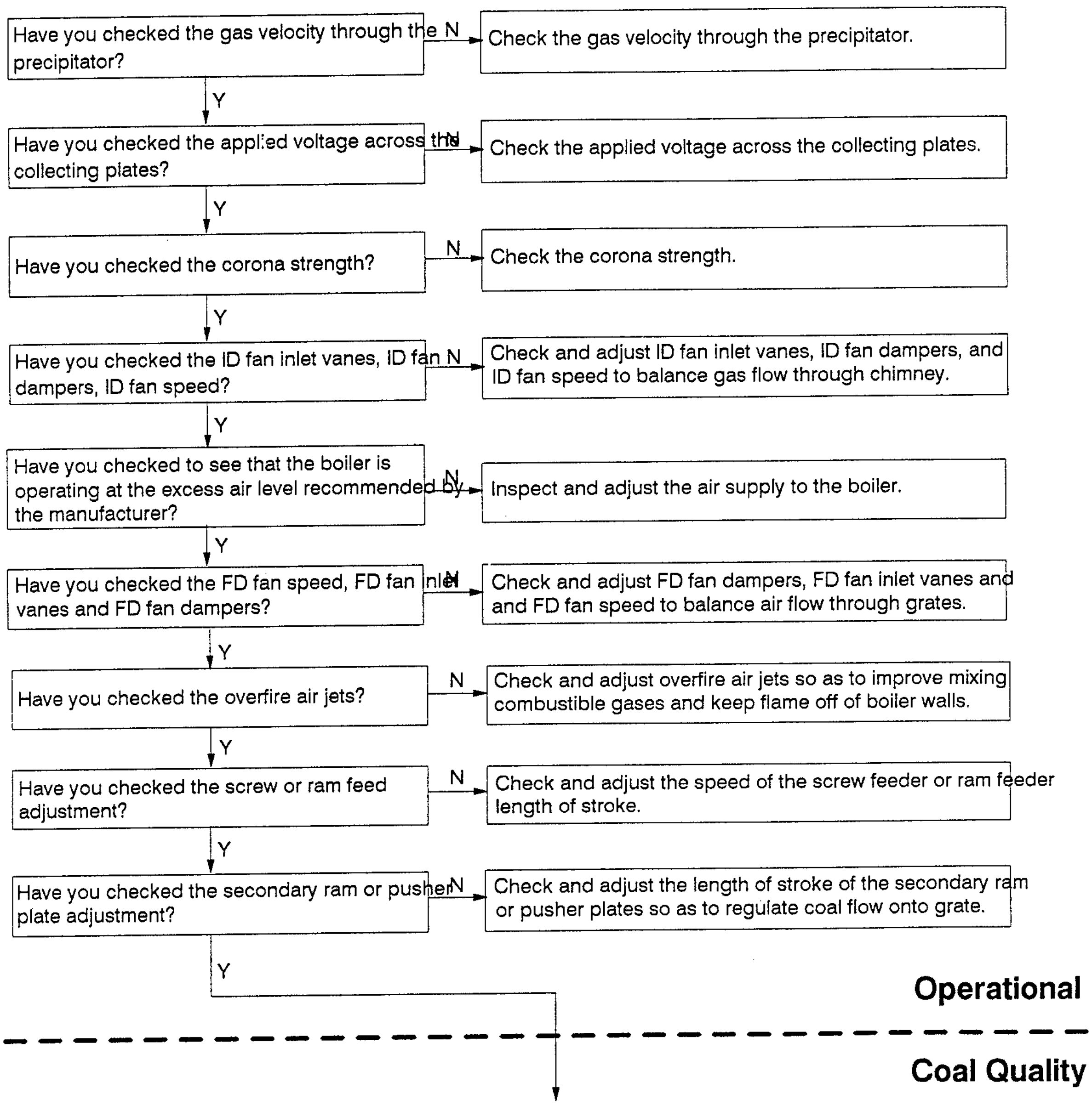
Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG3-87nb/3

FIGURE 3-88: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG3-88n/3

IGURE 3-88 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with eventually wearing away the metal surface.

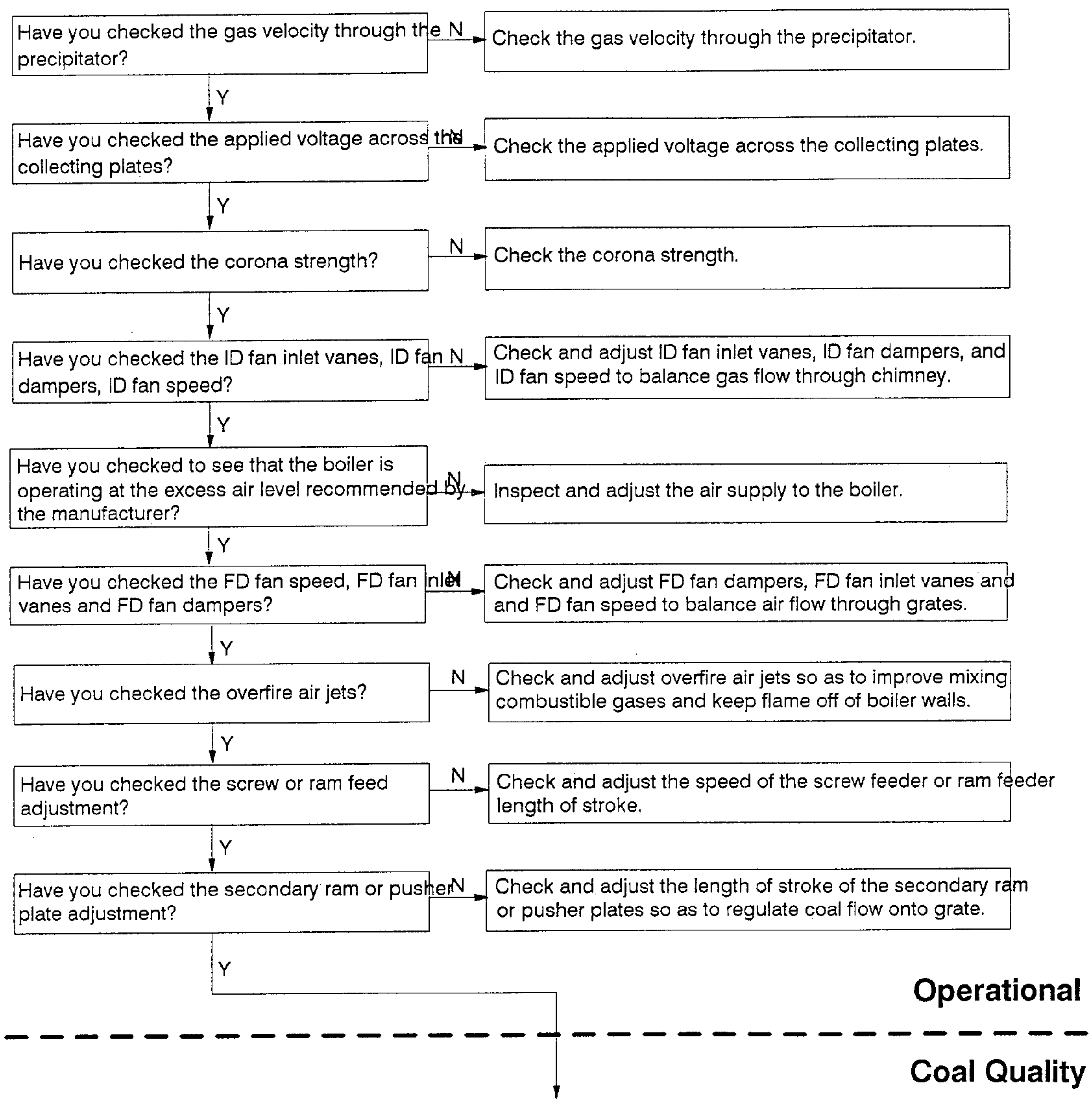
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with and eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with and wear away metal surfaces.

FIG3-88nb/3

FIGURE 3-89: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG5-89n/3

IGURE 3-89 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions The Particulate Removal System (Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Fly Ash Resistivity
2. High Ash
3. Low Sulfur
4. Excess Fines
5. Low Moisture

(See Appendix A For Test Methods)

Fly Ash Resistivity - The resistivity of the fly ash is the key parameter which limits the applied voltage and hence the collection efficiency for a given precipitator design and operating configuration.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace. A high calcium content in the ash reduces the effective sulfur trioxide concentration, thereby decreasing precipitator performance. Sulfur trioxide is important in the resistivity mechanism because water molecules in combination with sulfur trioxide are absorbed on the surface of the ash particles and form a conductive film, shich decrease resistivity.

Low Sulfur - Ash from coals low in sulfur is more difficult to precipitate than ash from higher sulfur coals.

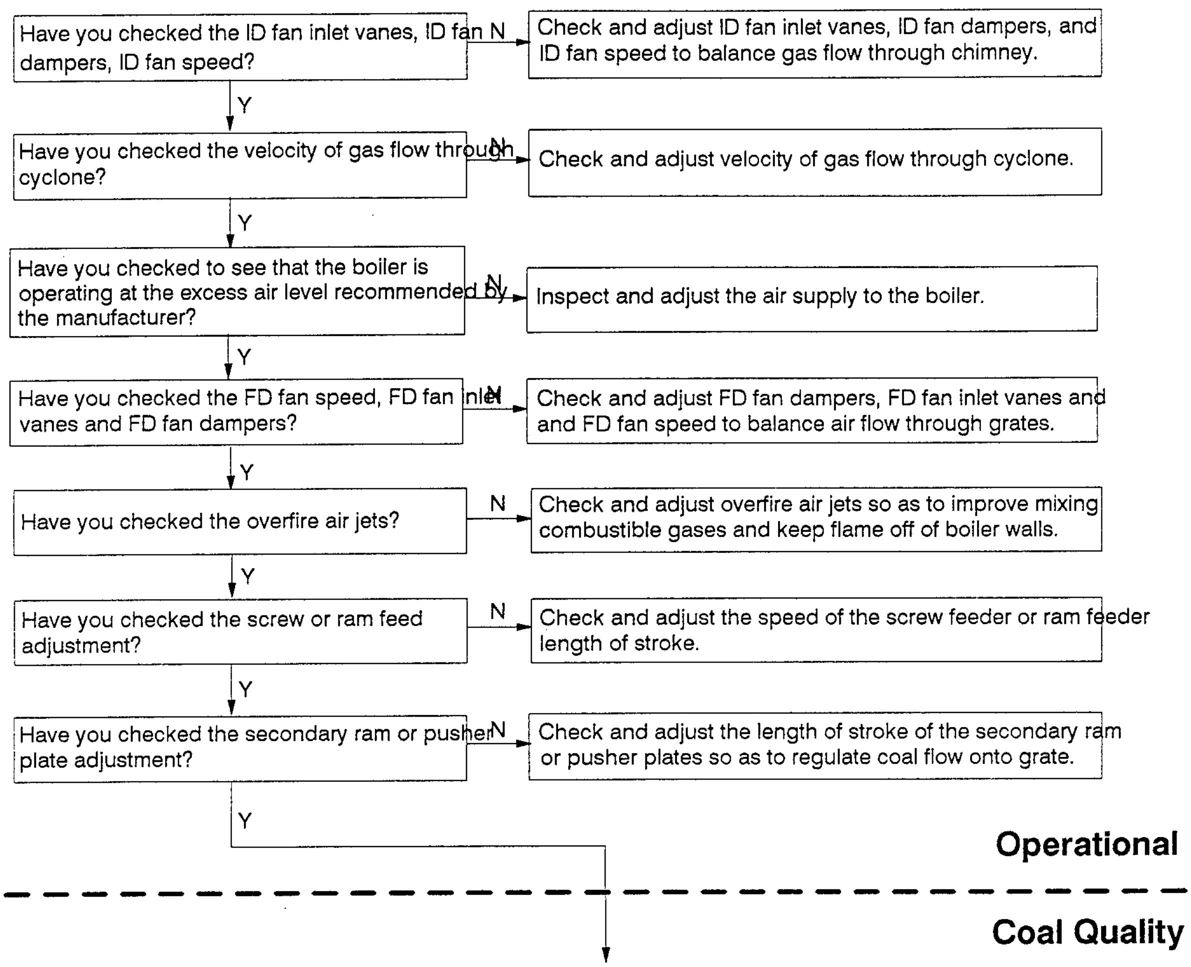
Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG3-89nb/3

FIGURE 3-90: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System



See next page for Coal Quality Section.

FIG3-90n/3

IGURE 3-90 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Fly-Ash Recycle

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG3-90nb/3

FIGURE 3-91: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers In The Ash Pit/Hopper

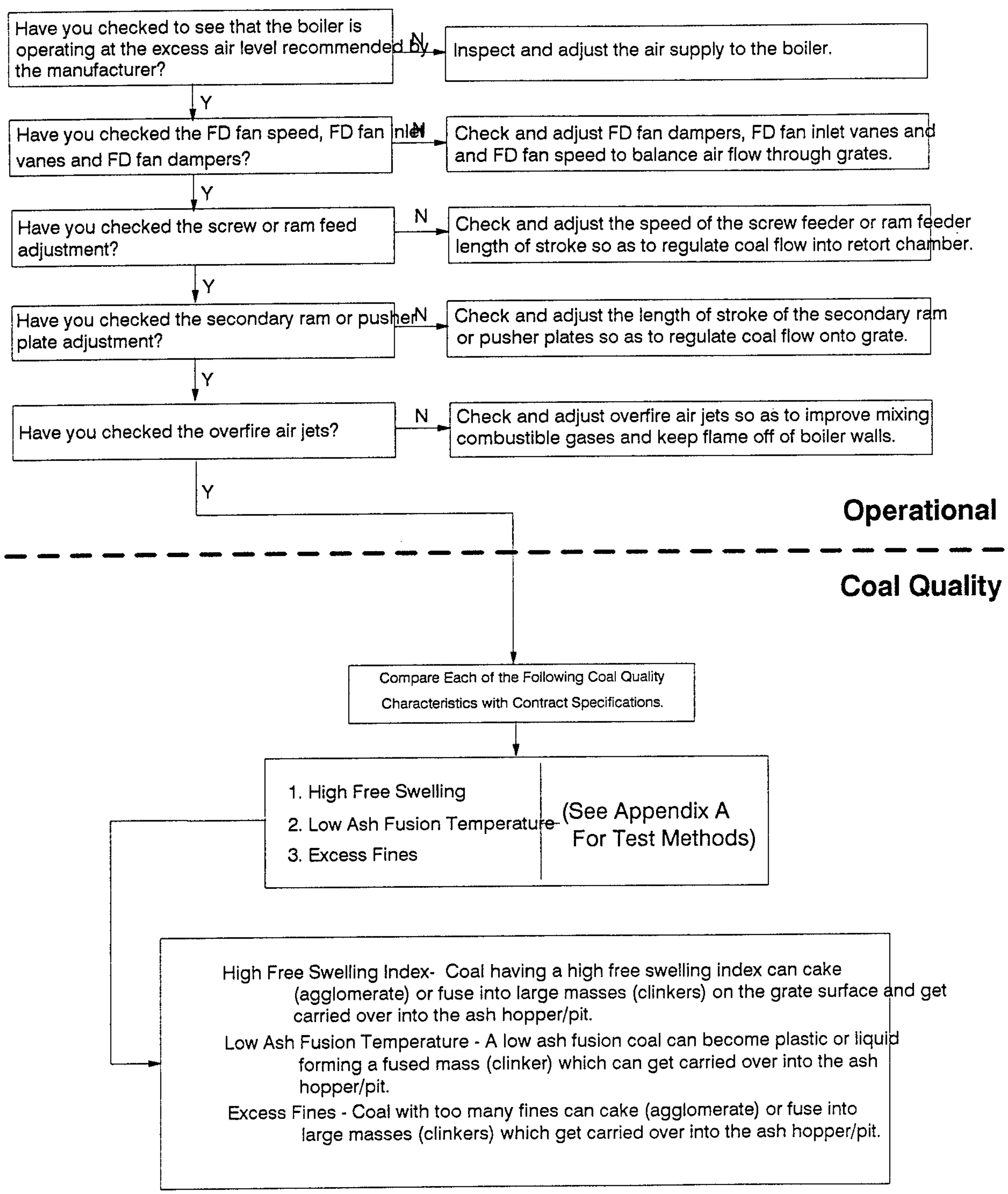


FIG3-91n/2

FIGURE 3-92: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Ash Pit/Hopper

Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer?
- N → Inspect and adjust the air supply to the boiler.
- Y ↓

Have you checked the FD fan speed, FD fan inlet vanes and FD fan dampers?
- N → Check and adjust FD fan dampers, FD fan inlet vanes and FD fan speed to balance air flow through grates.
- Y ↓

Have you checked the screw or ram feed adjustment?
- N → Check and adjust the speed of the screw feeder or ram feeder length of stroke so as to regulate coal flow into retort chamber.
- Y ↓

Have you checked the secondary ram or pusher plate adjustment?
- N → Check and adjust the length of stroke of the secondary ram or pusher plates so as to regulate coal flow onto grate.
- Y ↓

Have you checked the overfire air jets?
- N → Check and adjust overfire air jets so as to improve mixing combustible gases and keep flame off of boiler walls.
- Y ↓

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG3-92n/3

FIGURE 3-93: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Stack/Chimney

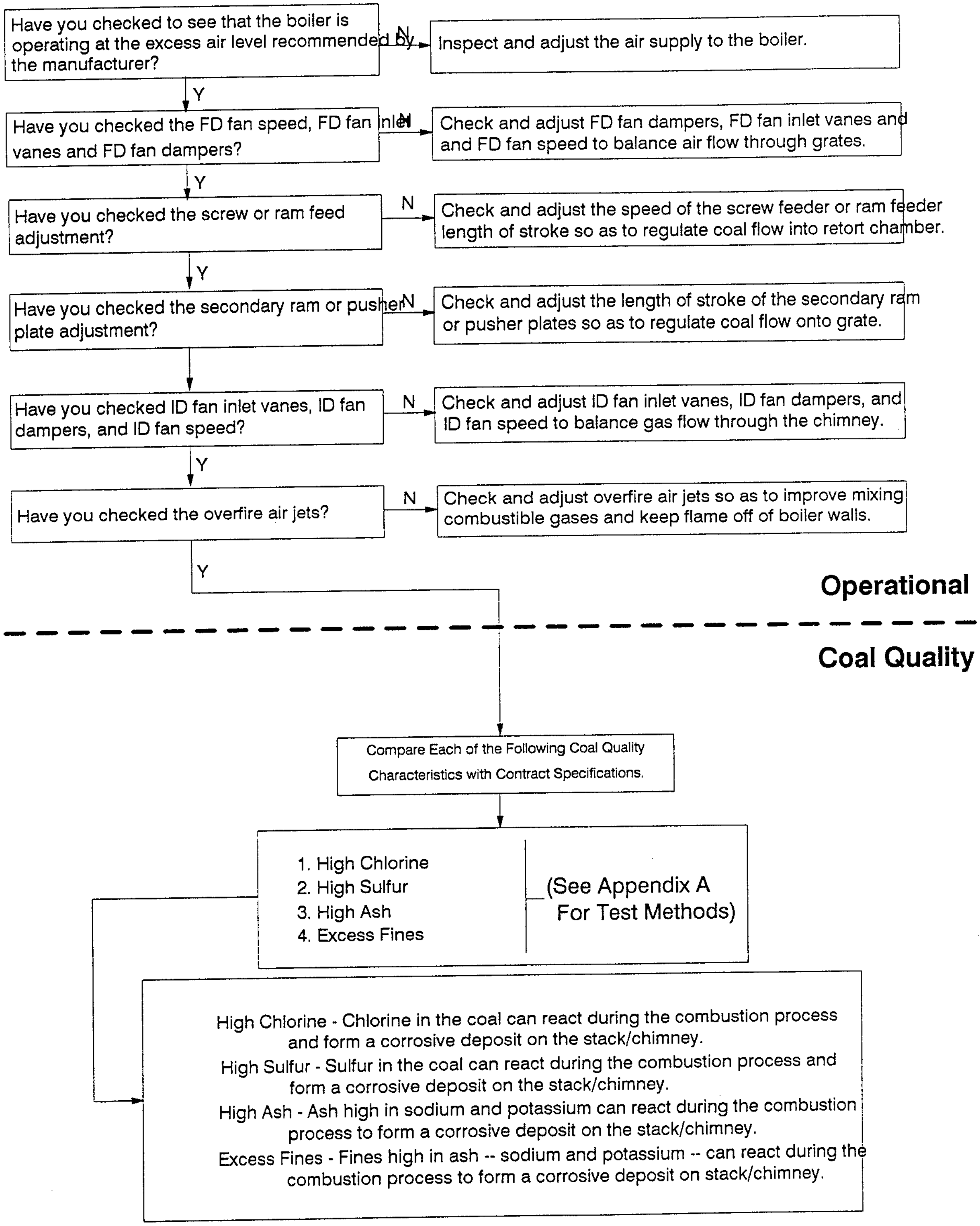
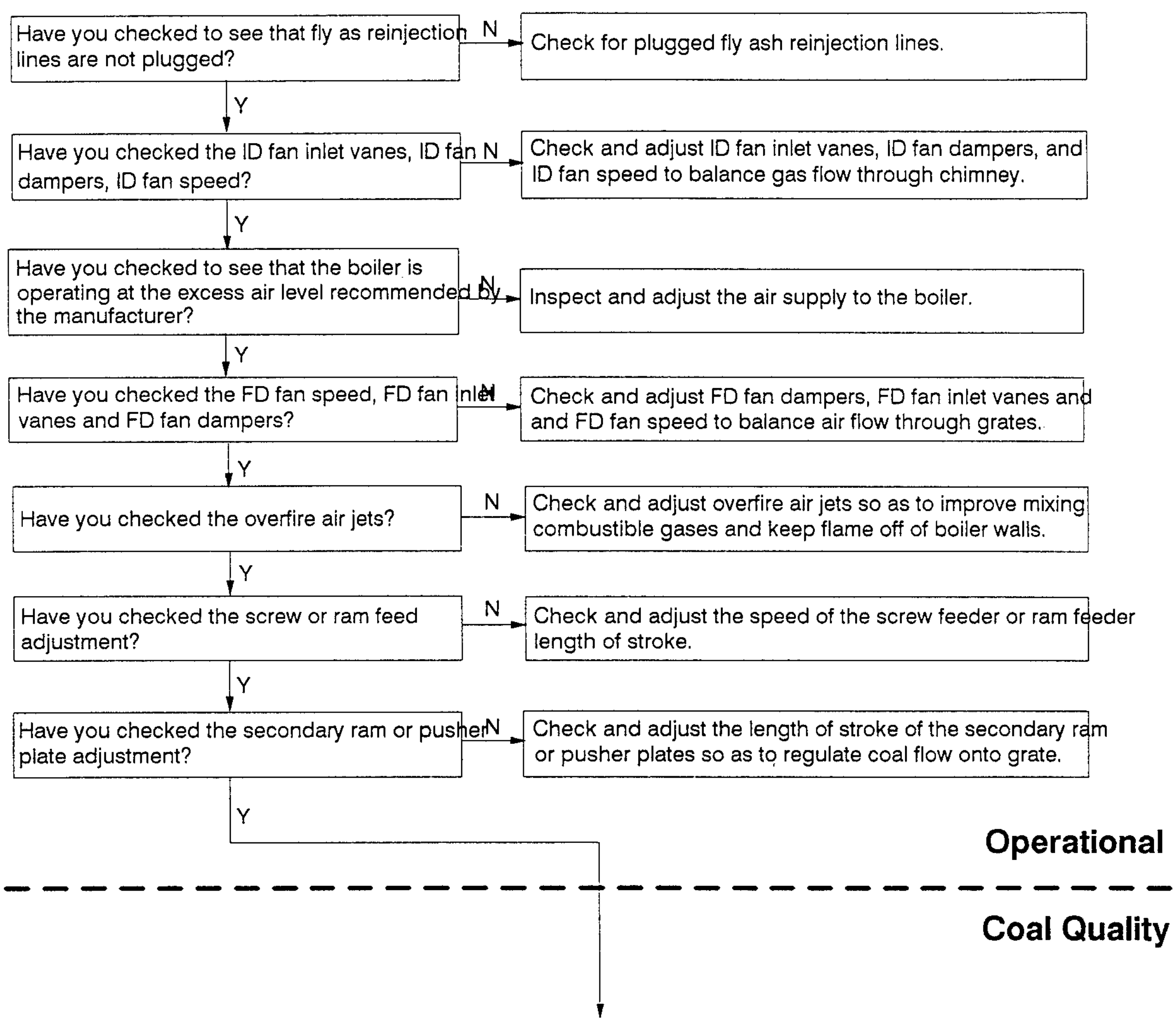


FIG3-93n/3

FIGURE 3-94: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Stack/Chimney



See next page for Coal Quality Section

FIG3-94n/3

'IGURE 3-94 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAI
For Carbon Burnout In The Stack/Chimney

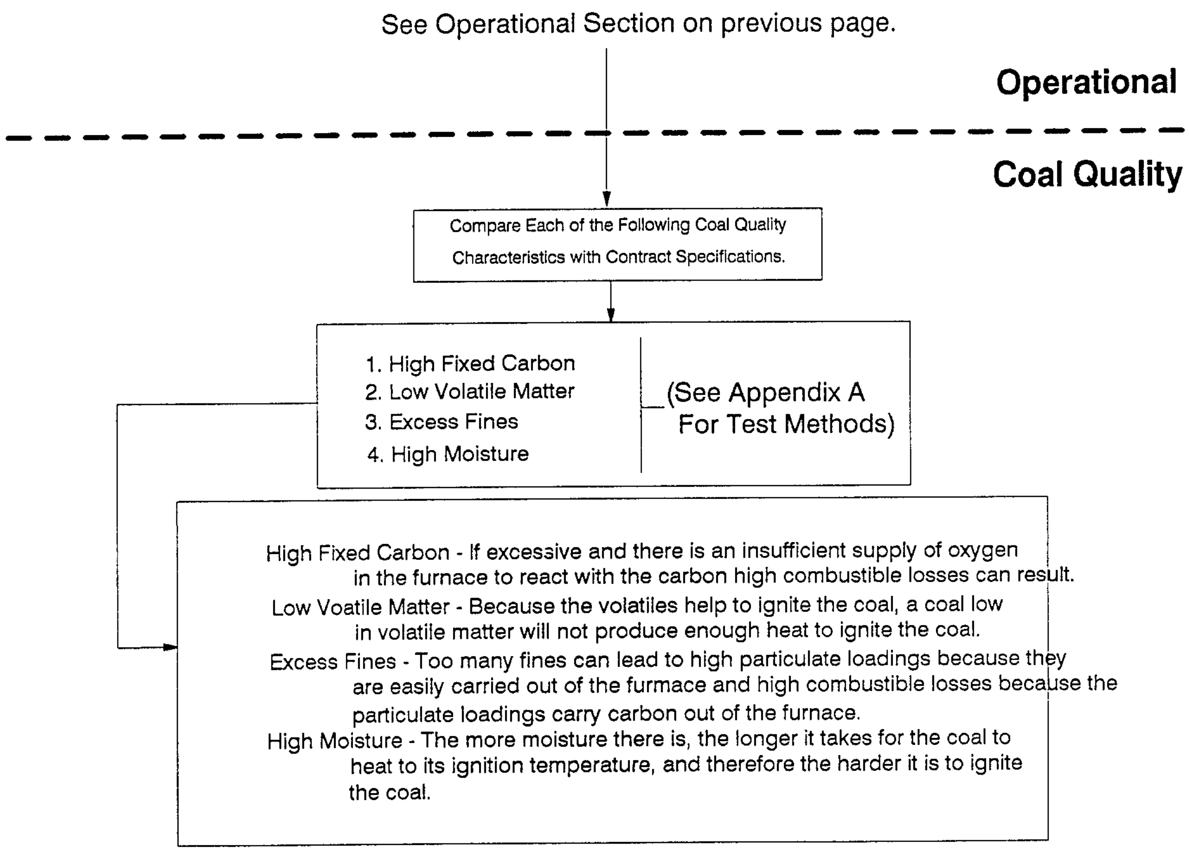
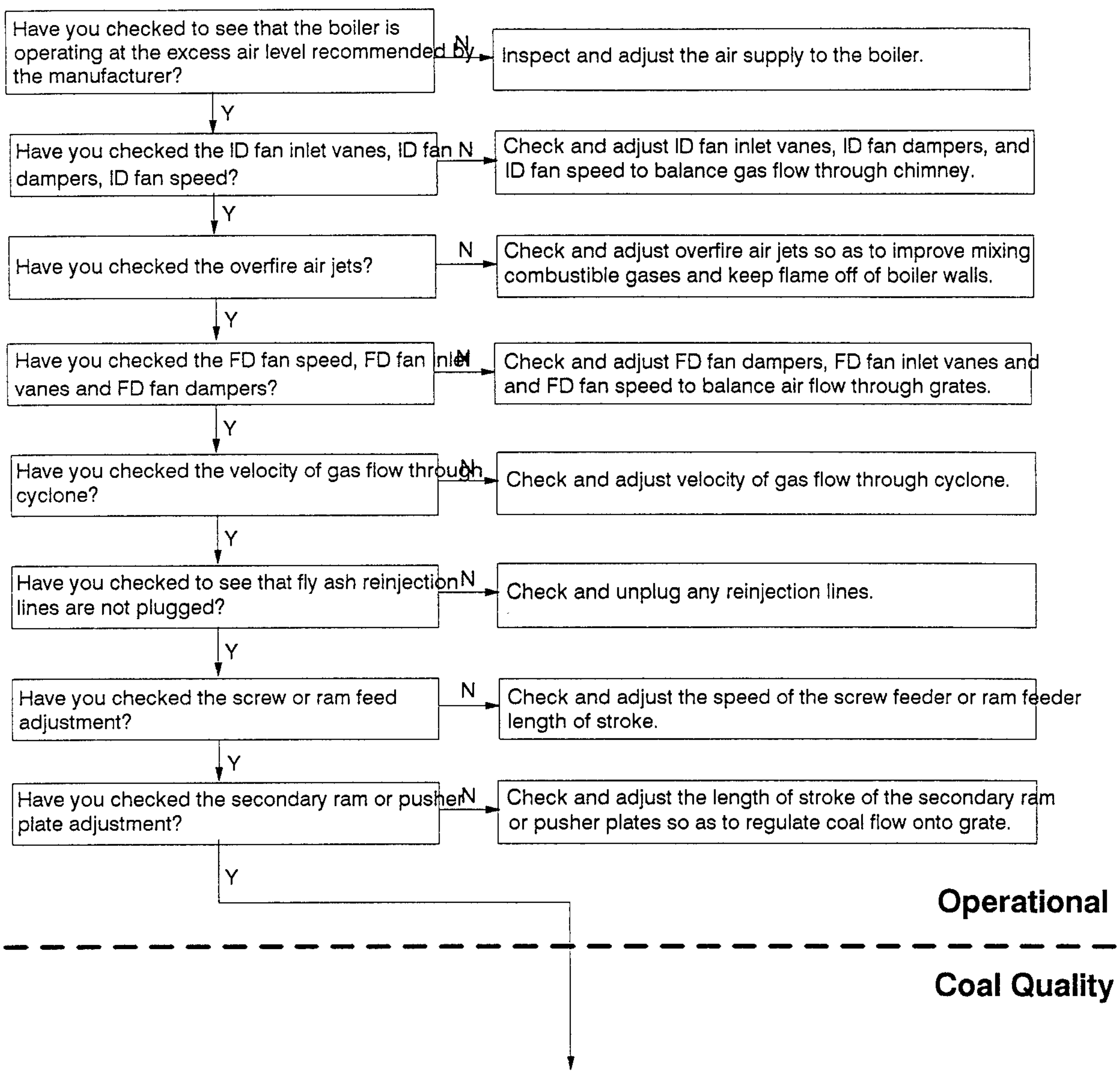


FIG3-94nb/3

FIGURE 3-95: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Stack/Chimney



See nest page for Coal Quality Section

FIG3-95n/3

IGURE 3-95 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAI
For Smoking From The Stack/Chimney

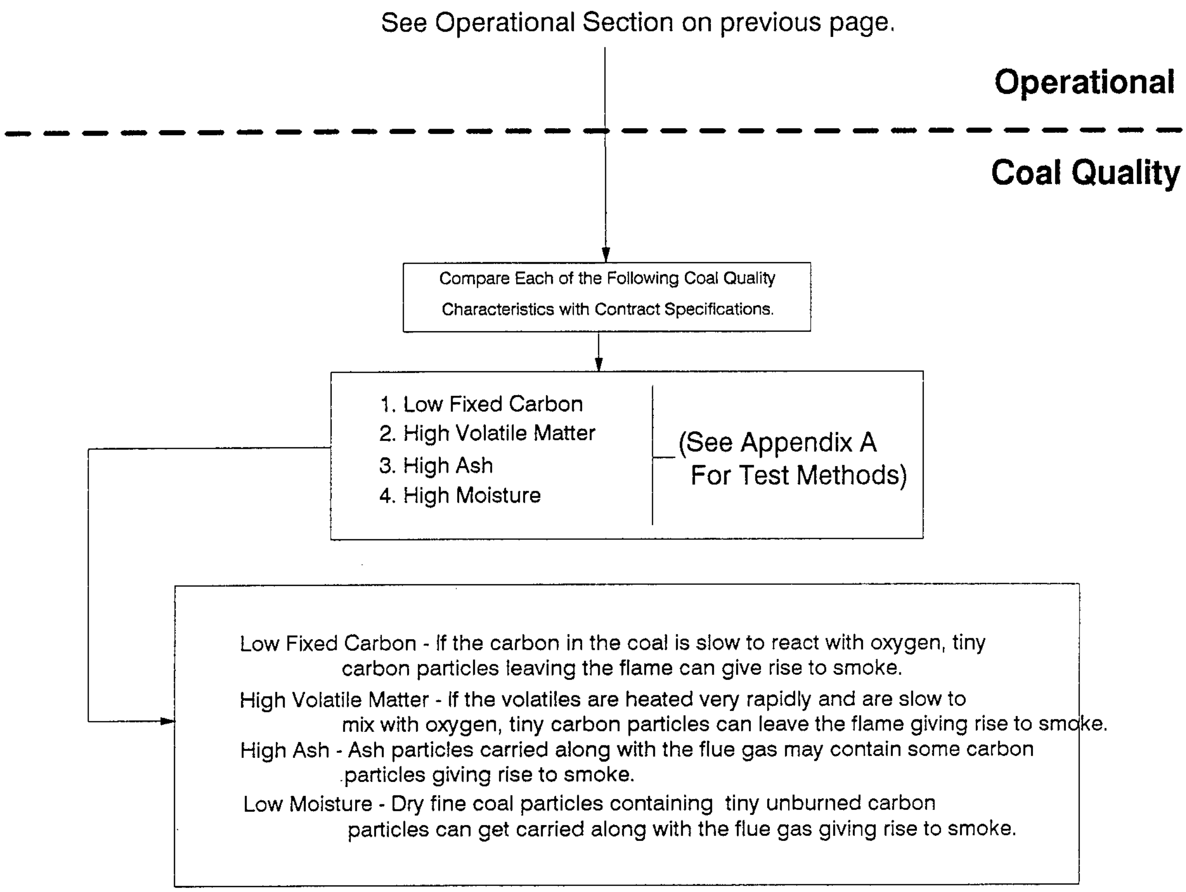
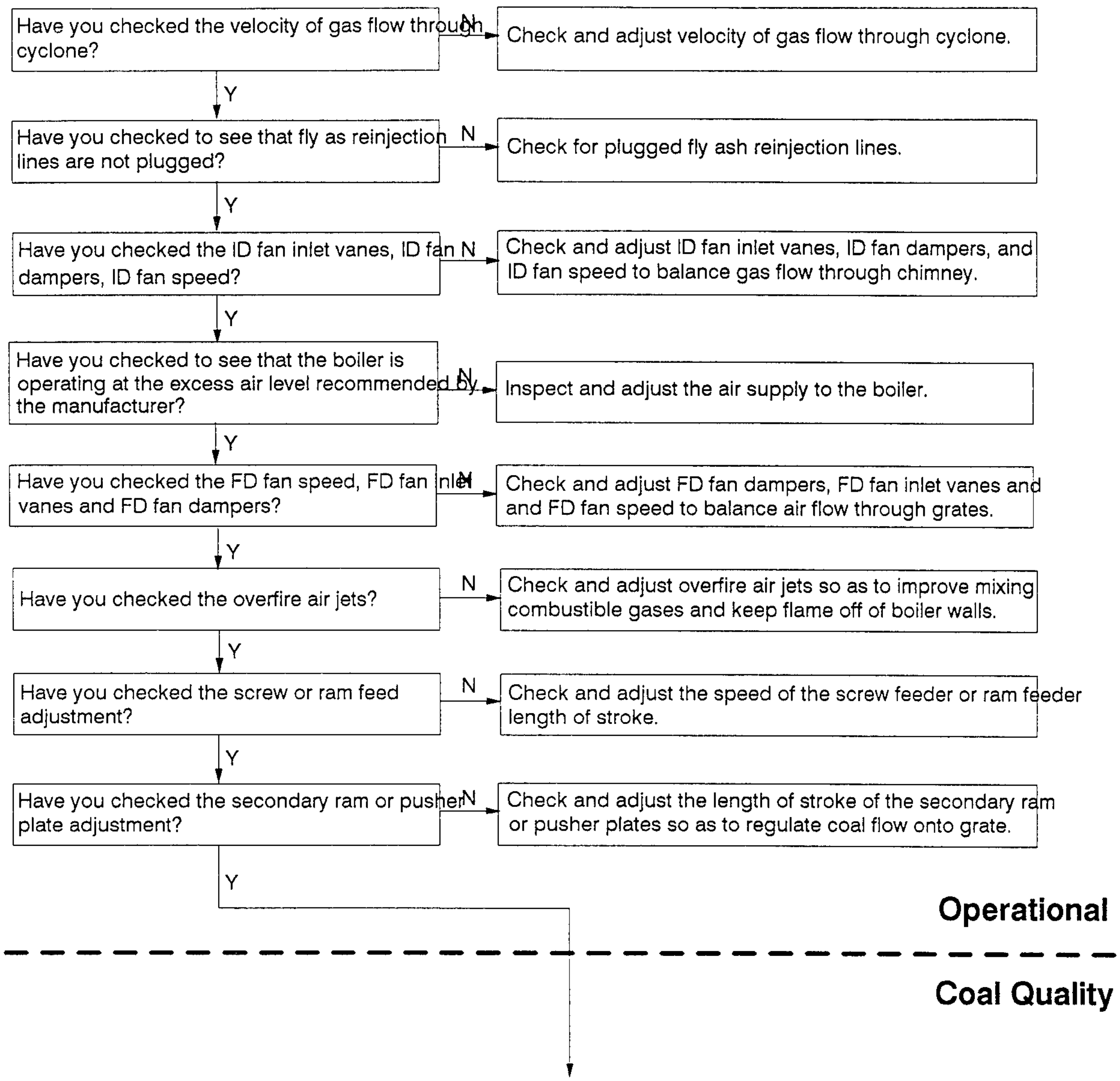


FIG3-95nb/3

FIGURE 3-96: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section

FIG3-96n/3

IGURE 3-96 (continued): UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Stack/Chimney

See Operational Section on previous page.

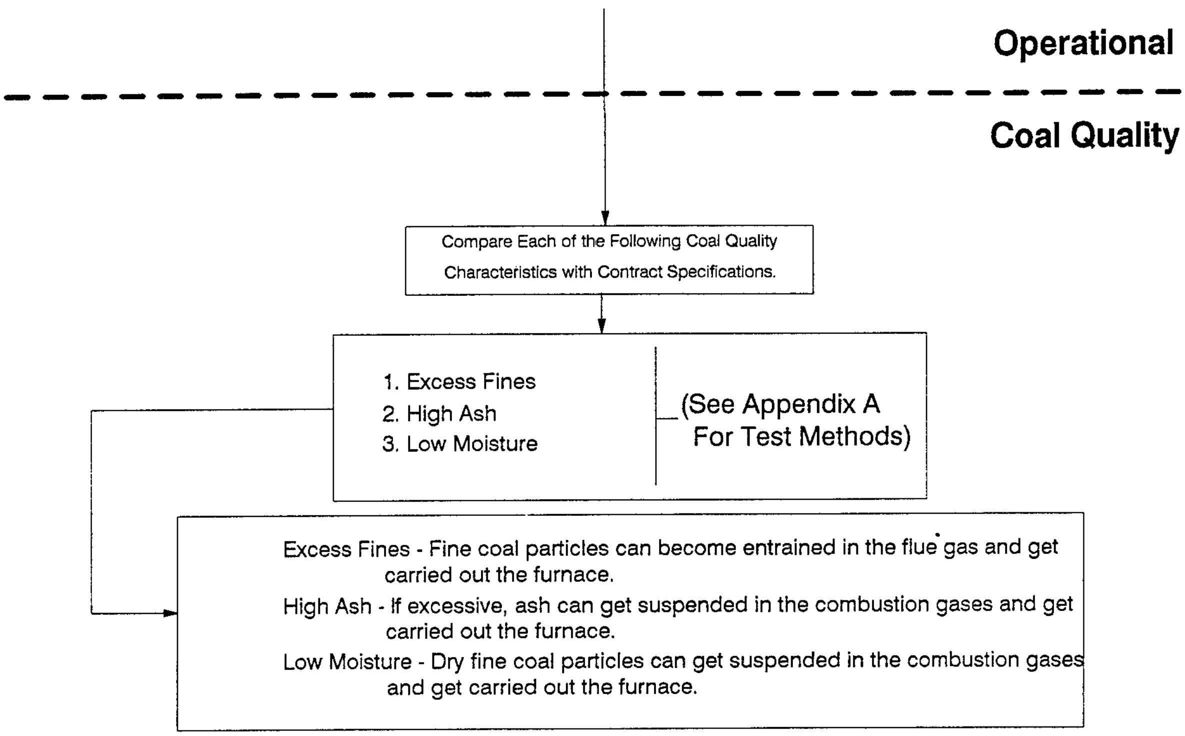


FIG3-96nb/3

FIGURE 3-97: UNDERFEED STOKER TROUBLESHOOTING LOGIC DIAGRAM For SO_2 Emissions From The Stack/Chimney

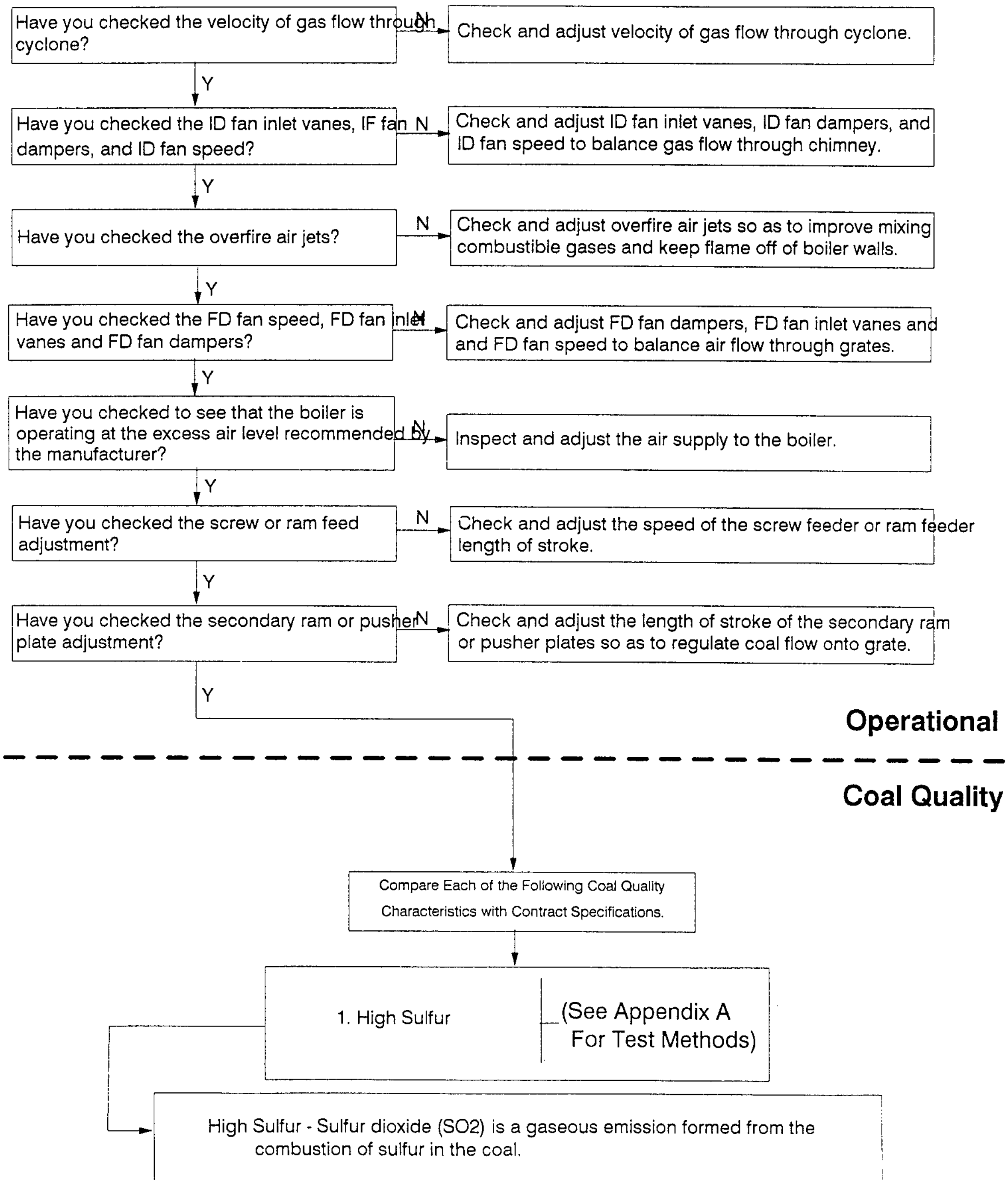


FIG3-97n/3

Appendix D: Top-Feed Static Grate Stoker-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality-related problems that may be encountered in the top feed static grate stoker-fired boiler system. A general description of the system is included, but is limited to describing the system currently operating at the Fliegerhorst Heating Plant, manufactured by Kewanee Boilers of the United States, and at the Baumholder Heating Plant manufactured by Robey of Lincoln Ltd., West Germany.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

D1 System Description

D1.1 The Fliegerhorst Heating Plant

The Fliegerhorst Heating Plant consists of four identical units manufactured by Kewanee Boilers in the United States. The recorded thermal design of each boiler is approximately 5.86 MW, with a total plant capacity of 23.45 MW. The units are three-pass, fire-tube, wet back boilers with an allowable working pressure of 10 bars (145 psig).

Delivered coal is normally unloaded directly into a hydraulically activated, tilting Kipp bunker for direct feed to the boiler day bunkers or, alternately, to adjacent garage-type coal storage enclosures. The coal storage facilities consist of six enclosed but open-front sectionalized garage bins, with an aggregate capacity of approximately 800 metric tons. It is possible to by-pass the tilting Kipp bunker and pneumatically convey coal from the garage bins to the boiler day bunkers. Coal is unloaded with moveable, inclined, vibratory conveyors and flexible hose connections to the pneumatic conveying system.

Coal stored in the Kipp bunker is pneumatically conveyed to two 6-ton/day bunkers located above each boiler. Coal is withdrawn from the bottom of a day bunker with a speed-controlled auger, is pneumatically conveyed to a cyclone separator on top of the boiler, and then is fed to a fixed grate via an integral drop tube and a cast iron cone, which distributes the coal onto a stationary grate. As the coal level in 1-day bunker drops, a level probe is activated to switch to the reserve bunker and refill the now-empty bunker. Alternate filling and emptying of the bunkers is carried out under automatic control. The coal feed rate is controlled automatically to respond to firing-rate changes by:

- preadjusting the variable-speed feed augers from the day bunkers
- automatically activating the pneumatic conveying system supplying coal to the cyclone separator.

The control variable is boiler steam operating pressure.

Ash is removed from the boiler hearth by manual hand-ranking. The ash is raked into standard ash dollies at the front of each boiler and is manually wheeled outside the building, where it is dumped onto the ground for truck disposal. Ash-removal procedures involve a systematic shutdown of the forced-air and coal-feed systems prior to opening the hearth door.

A forced-draft fan mounted on the front and top of each boiler supplies both primary and secondary combustion air. Control dampers regulate the split, with secondary air passing down the outside of the coal feed drop tube and primary air moving through a wind box and the underside of the hearth grates. The boilers are operated under positive pressure (about 0.25 to 0.30 psig). The boilers as presently installed do not have any means of adjusting the amount of excess air provided to the boilers for combustion. The amount of excess air is pre-set by the size of the orifice plate through which the air is supplied.

Flue gas is withdrawn from the combustion chambers and passes through a multi-cyclone dust collector (one for each boiler). Flyash and grit collected in the multi-cyclone units are screw conveyed into dedicated pneumatic conveyors for reinjection into the combustion chambers of individual boilers. Flue gas is withdrawn from the multi-cyclone dust collectors by induced draft fans and discharged to the atmosphere through individual boiler chimney stacks. The induced-draft fans supply the energy necessary for operating the multi-cyclone dust collectors.

D1.2 The Baumholder Heating Plant

The Baumholder Heating Plant consists of four identical 5.814 MW units manufactured by Robey of Lincoln Ltd. The total plant capacity is 23.256 MW. The units are three-pass, combined flame/smoke-tube wet-back boilers with an allowable working pressure of 10 bars (145 psig).

Coal is delivered into the coal yard by train and is tipped from a coal hopper in the yard, conveyed to the roof of the heating plant by a vertical chain-conveyor system, and dropped into a horizontal chain-conveyor system that moves the coal into day bunkers. The capacity of each day bunker is 325 metric tons, sufficient for 7 operating days at full load. There is a coal-weighing system at the intersection of the vertical and horizontal conveyors.

Coal is moved from each day bunker by a screw conveyor and pneumatic conveyor system (controlled in accordance with the desired boiler load) through the steam and water area of the system to the center of the fixed grate of each boiler, where the distributor mechanism feeds coal evenly throughout the grate.

Ash is removed from the boiler hearths manually into a filling bin, from which it is passed through a slag breaker for size reduction. The ash is then moved via a bucket wheel sluice into an ash bunker.

Primary air is directed to the underside of the grate by a blower located on one side of the boiler. Secondary air is introduced into the coal-feed conveyor and directed downward onto the grate, thus developing a slight overpressure within the furnace. Regulation of primary and secondary air is accomplished through an automatic control system on the blowers.

The flue gases are passed through a cyclone dust collector and then into the stack via an induced-draft fan and breeching system. The fine particulates separated in the dust collector are returned to the furnace by means of a pneumatic conveying system.

D2 Block Flow Diagram

The stoker-fired boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality) sequentially arranged to show:

- coal flow through the coal handling equipment
- flue gas flow through the boiler/components, flyash recycle, the induced draft fan, and chimney/stack
- ash discharge to the ash dollies.

These specific components are identified in Figure 4-1. The first five components have been grouped collectively under a category entitled coal handling equipment. The coal handling equipment includes all components that process the coal from its delivery on site to the cyclone separator. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, pneumatic conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- the cyclone separator that distributes the coal onto the grate.

The next four components have been loosely grouped under the category entitled Boiler/components. Again, it includes equipment that, depending on plant design, may include:

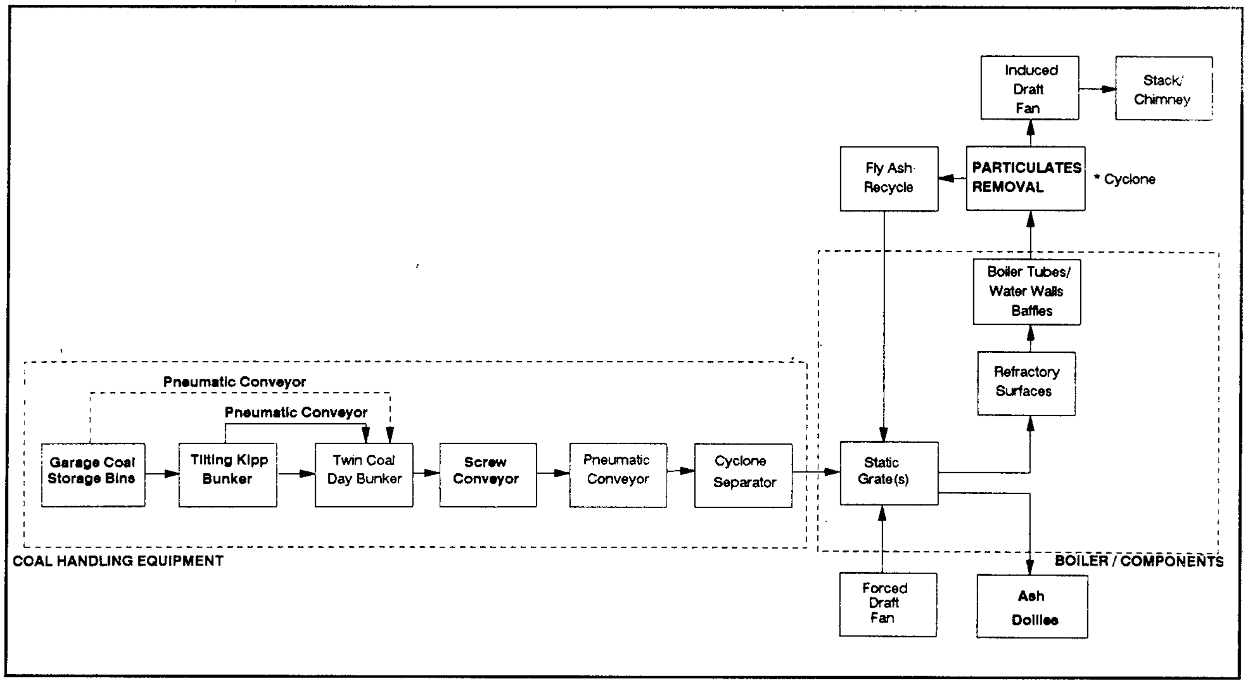


Figure 4-1. Top feed static grate stoker-fired boiler system components block flow diagram.

- forced draft fan
- grates—specifically stationary
- refractory surfaces
- heat transfer surfaces (boiler tubes, water walls and baffle).

The next two blocks represent the flyash recycle and the particle removal subsystem. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. Top-feed static grate stoker-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the guide include:

- forced draft (FD) fans, which supply undergrate air
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the Guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/pit.

D3 Troubleshooting Logic

The component/symptom guide table (Figure 4-2) serves to identify:

- Typical symptoms (problems) that may be encountered in top-feed static grate stoker-fired boiler systems. These symptoms are arranged horizontally along the top of the table
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram
- The logic diagrams.

The remainder of this Appendix consists of 53 logic diagrams, arranged by component and by all the symptoms that can affect that component.

I-2 (Part 1): TOP FEED STATIC GRATE STOKER - COMPONENT/SY

SYMPTOM

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																				
Coal Bunker		● 4-3	● 4-4	● 4-5																
Automatic Coal Reclaim																				
Screw Feeder	● 4-6	● 4-7	● 4-8	● 4-9																
Coal Feed Conveyor																				
Pneumatic Conveyor	● 4-10	● 4-11	● 4-12	● 4-13																
Cyclone Seperator	● 4-14	● 4-15	● 4-16	● 4-17																
BOILER / COMPONENTS																				
Boiler			● 4-18											● 4-19						
Static Grate					● 4-20		● 4-21	● 4-22	● 4-23	● 4-24	● 4-25	● 4-26	● 4-27							
Refractory Surfaces					● 4-28											● 4-29	● 4-30			
Boiler Tubes/Water Walls					● 4-31											● 4-32	● 4-33	● 4-34		
Baffles					● 4-35											● 4-36	● 4-37	● 4-38		

Figure 4-2. Top feed static grate stoker—component symptom guide (part 1).

FIGURE 4-2 (Part 2): TOP FEED STATIC GRATE STOKER - COMPONENTS/SYMPTOM GUIDE

COMPONENT \ SYMPTOM	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	SEGREGATION	PRESSURE DROP	UNEVEN ASH BED	UNEVEN COAL BED	UNEVEN BURNING	WARPED, BURNT, CRACKED	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS
FANS																				
1) Forced Draft			● 4-39												● 4-40					
2) Induced Draft			● 4-41		● 4-42										● 4-43	● 4-44				
PARTICULATE REMOVAL																				
Cyclone													● 4-45			● 4-46			● 4-47	
ASH HANDLING																				
1) Fly Ash Recycle													● 4-48							
2) Ash Dollie												● 4-49	● 4-50							
Stack/Chimney					● 4-51								● 4-52		● 4-53				● 4-54	● 4-55

Figure 4-2. Top feed static grate stoker—component symptom guide (part 2).

FIGURE 4-3: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM for Pluggage In The Coal Bunker

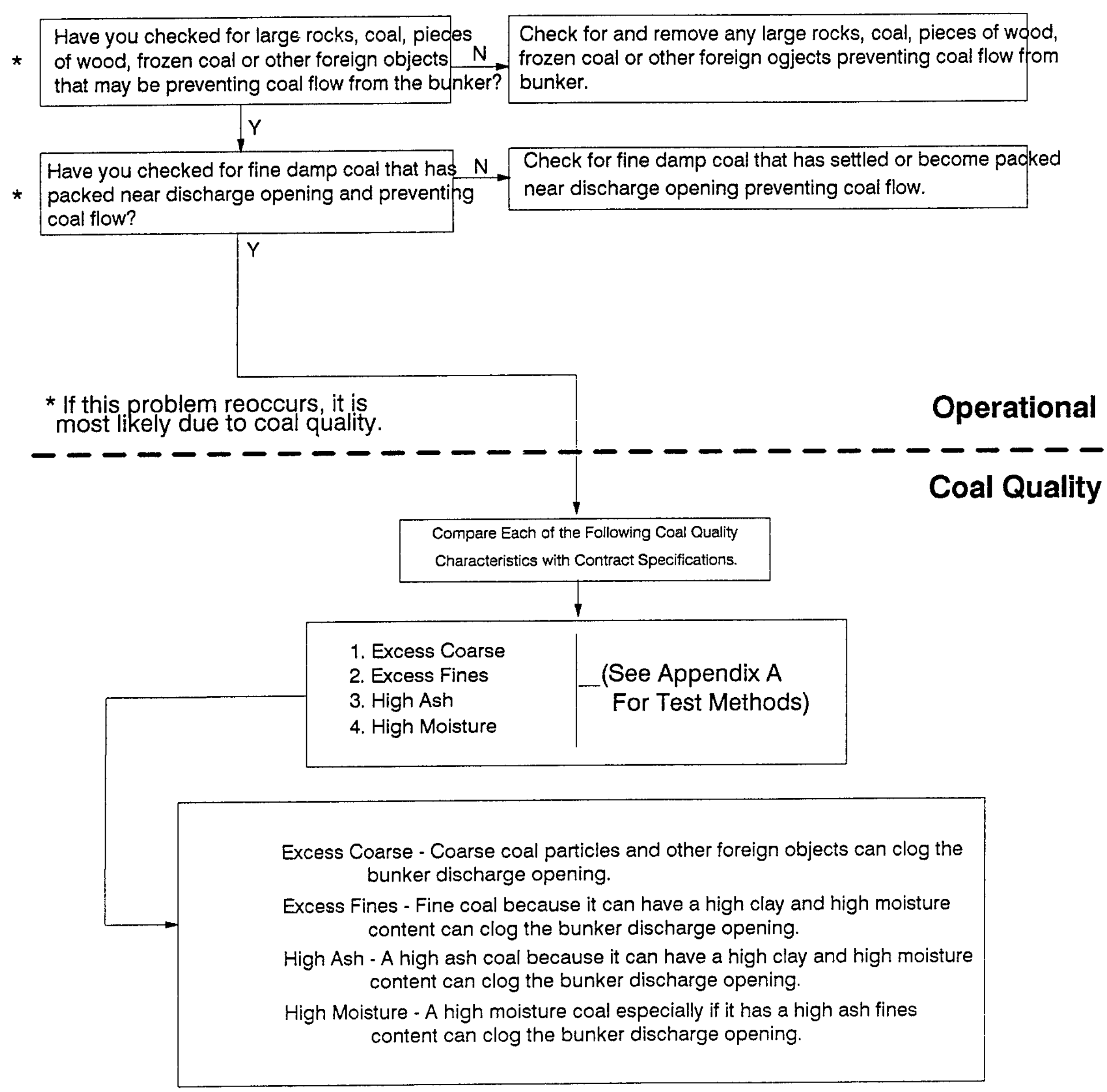


FIG4-3n/1

FIGURE 4-4: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Bunker

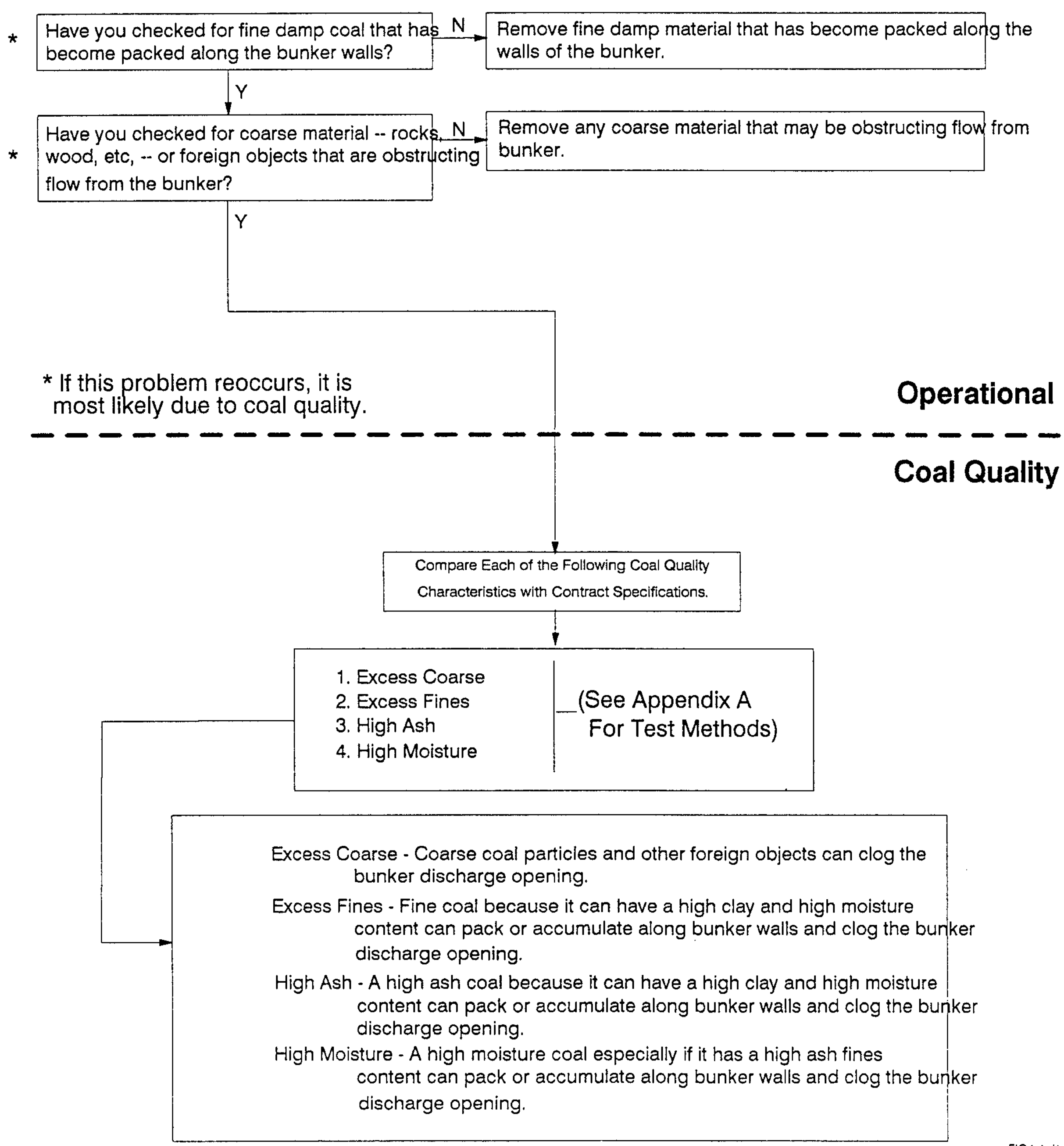


FIG4-4n/1

FIGURE 4-5: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Bunker

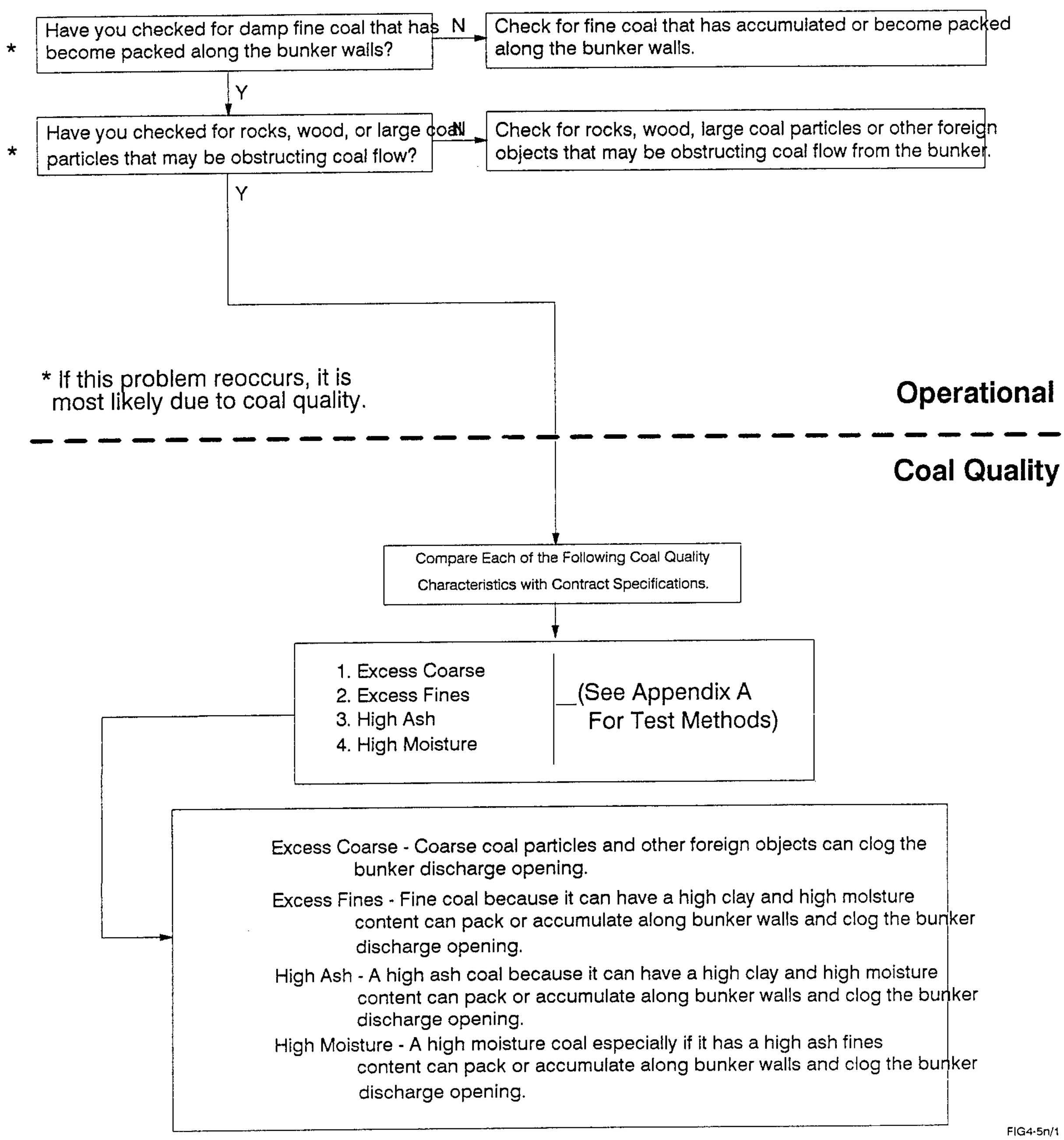


FIG4-5n/1

FIGURE 4-6: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim

(Screw Feeder)

* Have you checked to see that fine damp coal is Not packed in between the screw and the casing?
- N → Check to see that fine damp coal has not become packed in between the screw and the casing.
- Y ↓

Have you checked the speed at which the screw is turning (rotating)?
- N → Check and adjust the speed at which the screw is turning (rotating).
- Y ↓

Do you routinely inspect and maintain the screw auger to ensure its proper working condition?
- N → Inspect screw conveyor routinely.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion - Abrasion is the sandpaper effect of particles moving in contact with the screw feeder and the casing. A highly abrasive coal can therefore wear away the metal surfaces of the screw feeder.

Relative Free Quartz (RFQ) - The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash - A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can wear away the metal surface of the screw feeder.

FIG4-6n/1

FIGURE 4-7: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim

(Screw Feeder)

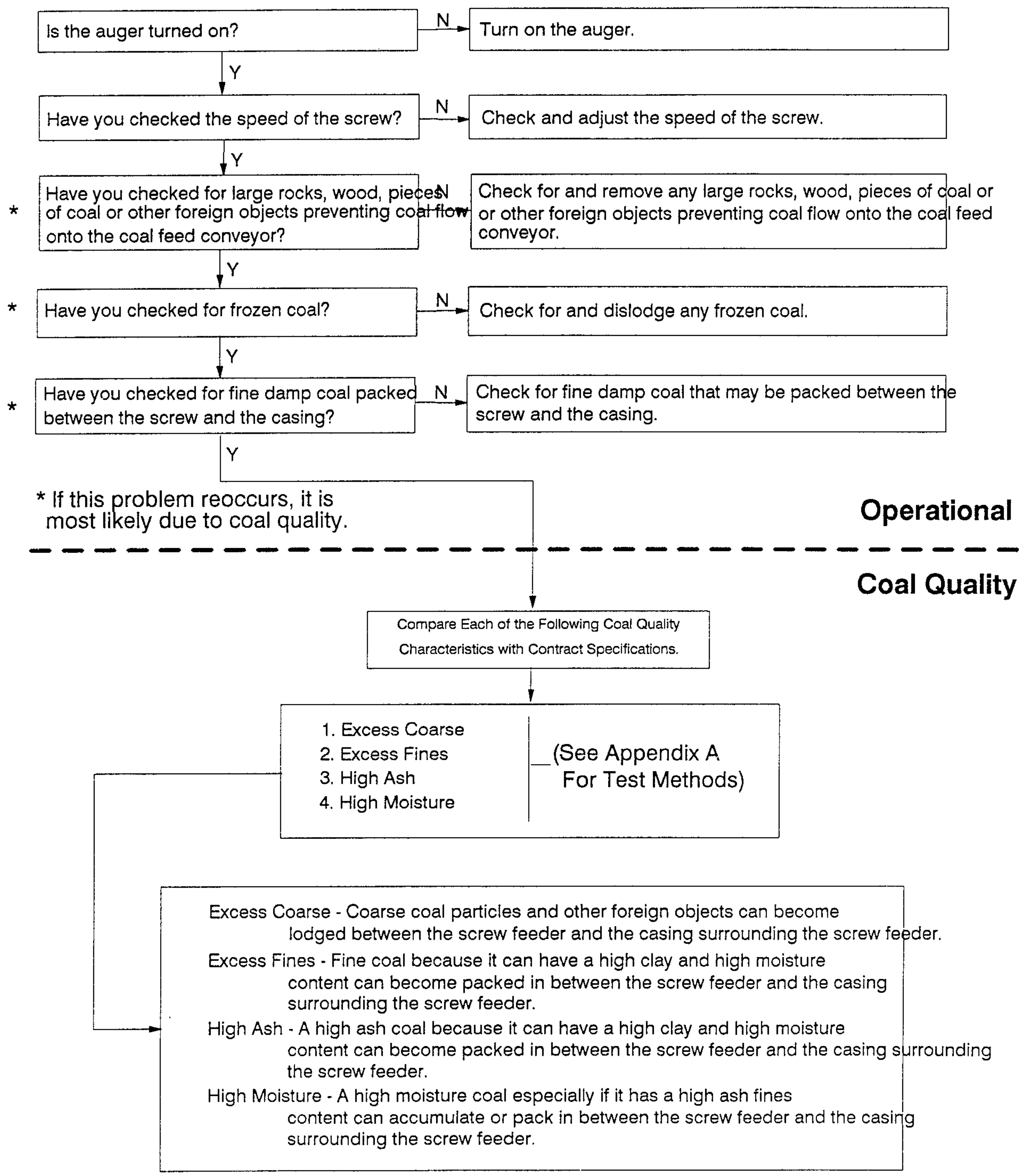


FIG4-7n/1

FIGURE 4-8: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim

(Screw Feeder)

Is the screw auger turned on? — N → Turn the auger on.

Y ↓

Have you checked the speed at which the screw is turning (rotating)? — N → Check and adjust the speed at which the screw is turning (rotating).

Y ↓

* Have you checked for large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor? — N → Check for and remove any large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor.

Y ↓

* Have you checked for frozen coal? — N → Check for and dislodge any frozen coal.

Y ↓

* Have you checked to see that fine damp coal is not packed in between the screw and the casing? — N → Check to see that fine damp coal has not become packed in between the screw and the casing.

Y ↓

Do you routinely inspect and maintain the screw feeder to ensure its proper working condition? — N → Inspect the screw feeder and maintain it to ensure its proper working condition.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw feeder and the casing surrounding the screw feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw feeder and the casing surrounding the screw feeder.

FIG4-8n/1

FIGURE 4-9: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feed From The Automatic Coal Reclaim

(Screw Feeder)

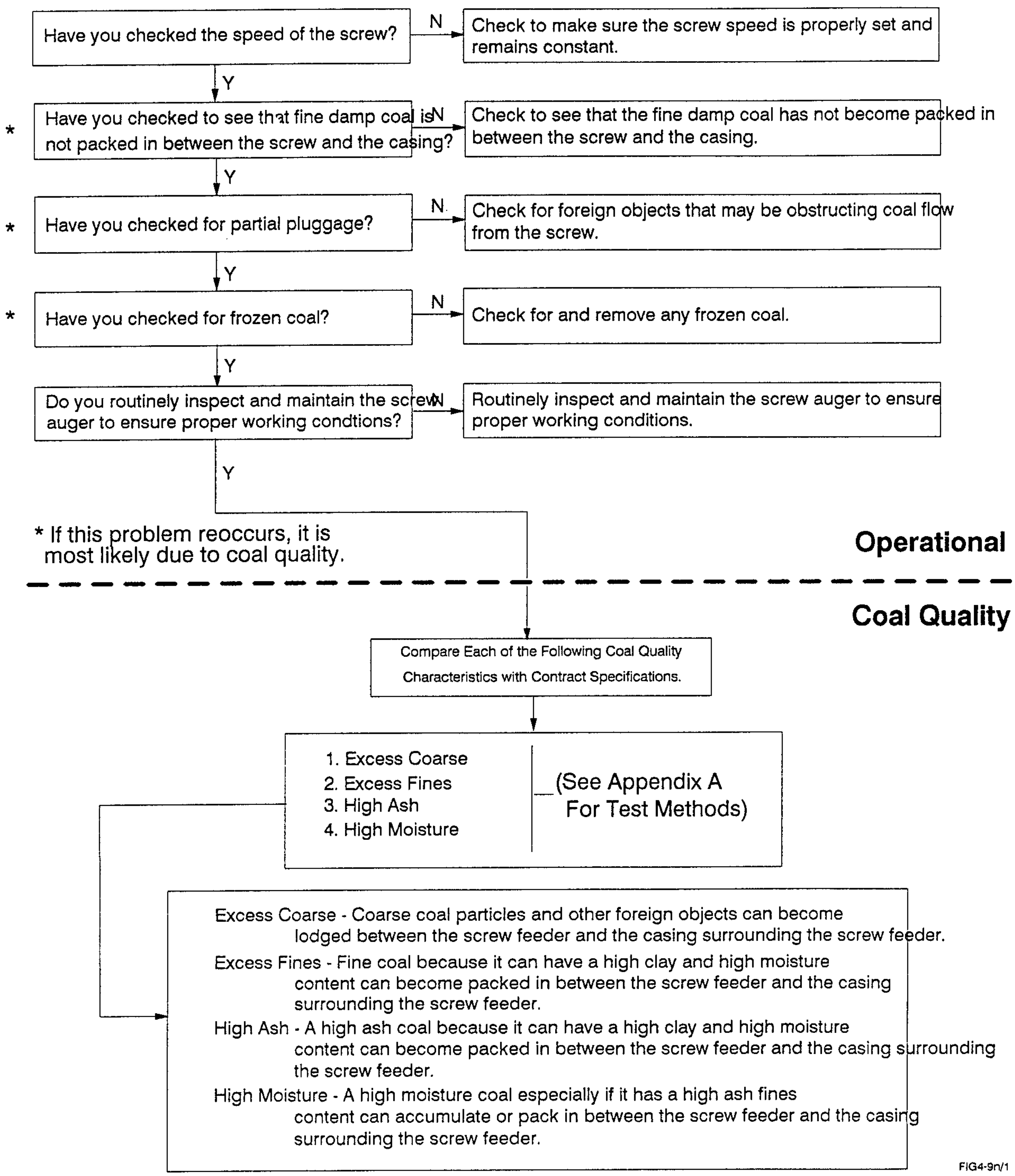


FIGURE 4-10: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

for Excess Wear In The Coal Feed Conveyor

(Pneumatic Conveyor)

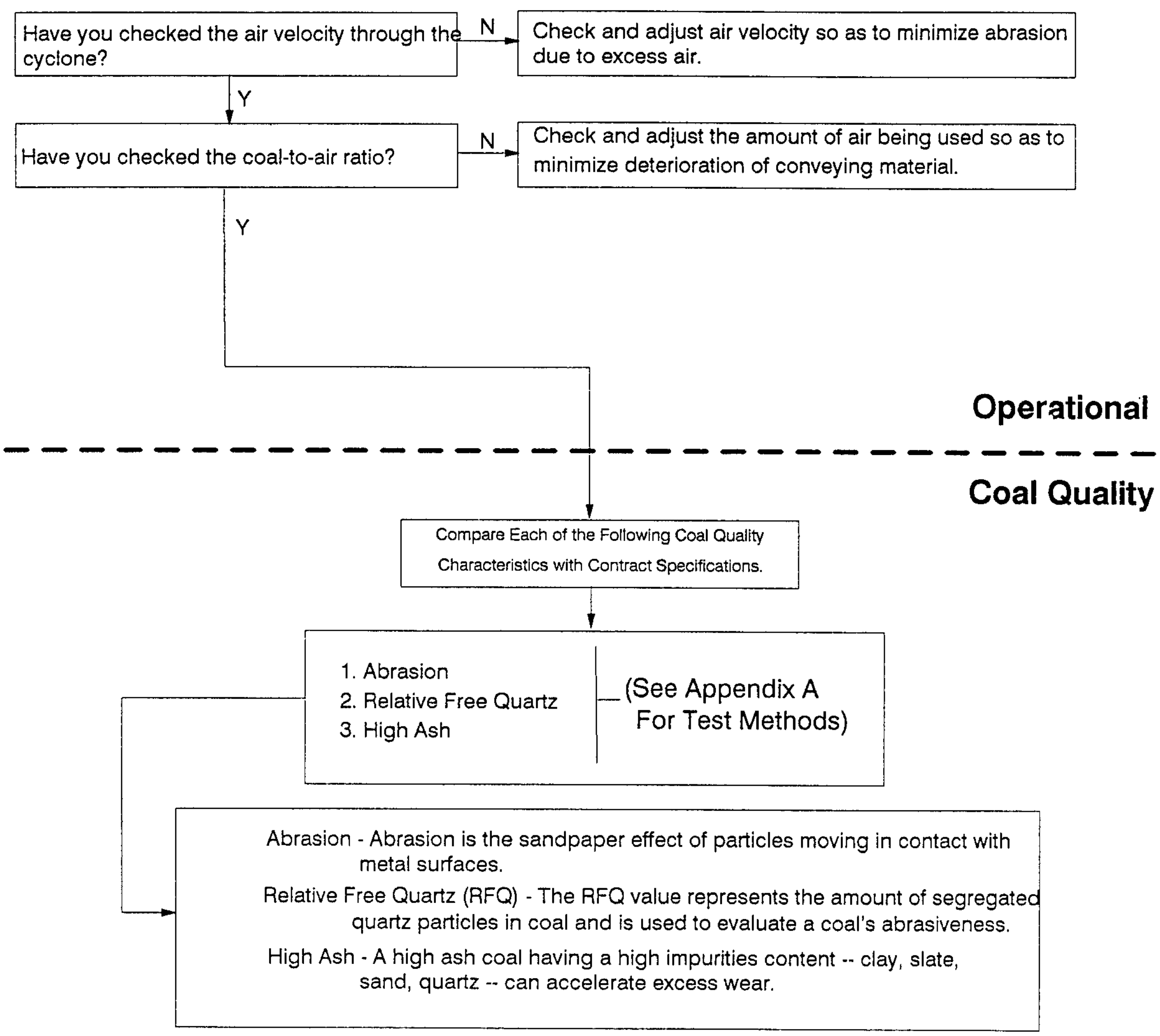


FIG4-10n/1

FIGURE 4-11: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage Of The Coal Feed Conveyor

(Pneumatic Conveyor)

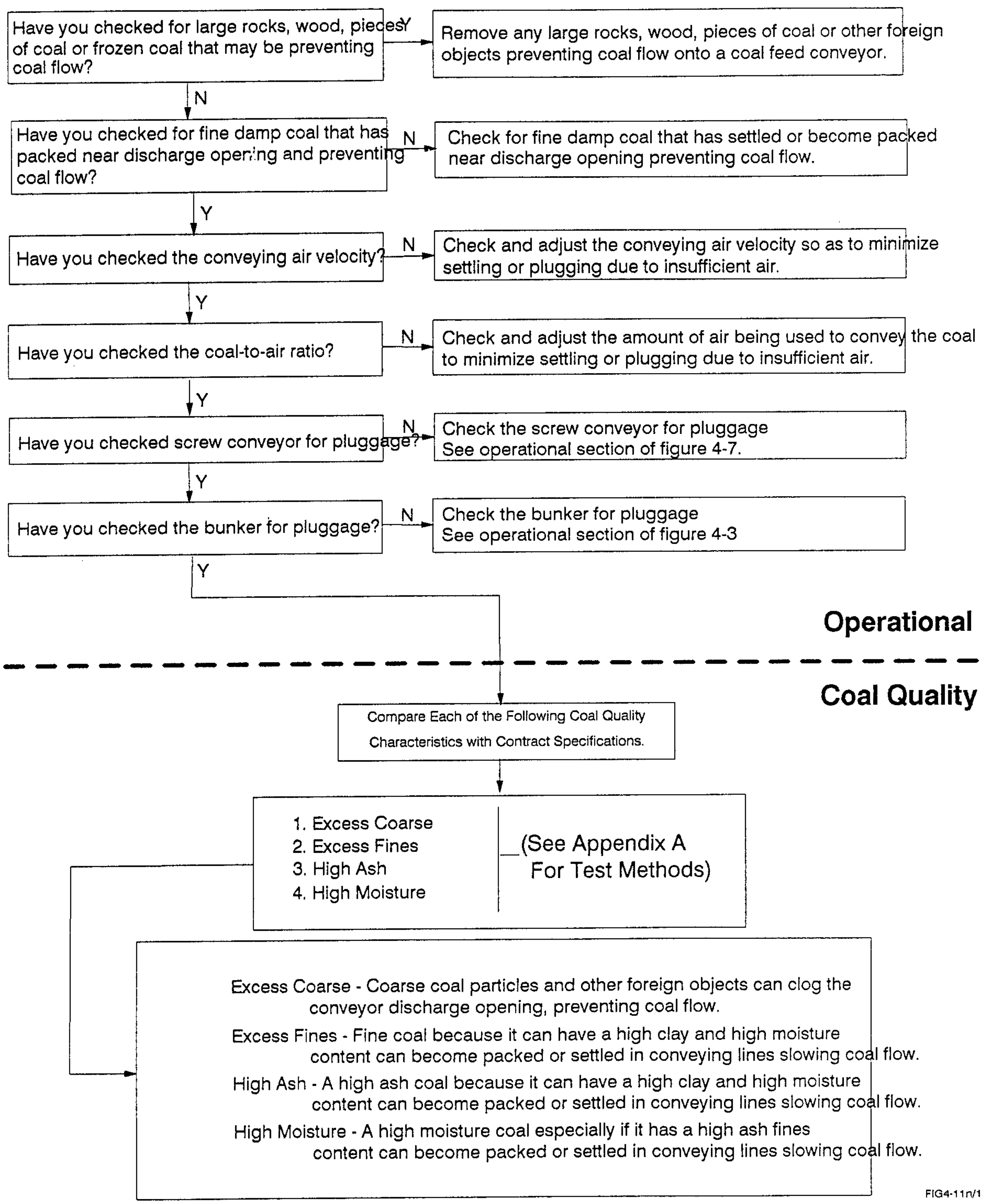


FIGURE 4-12: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor

(Pneumatic Conveyor)

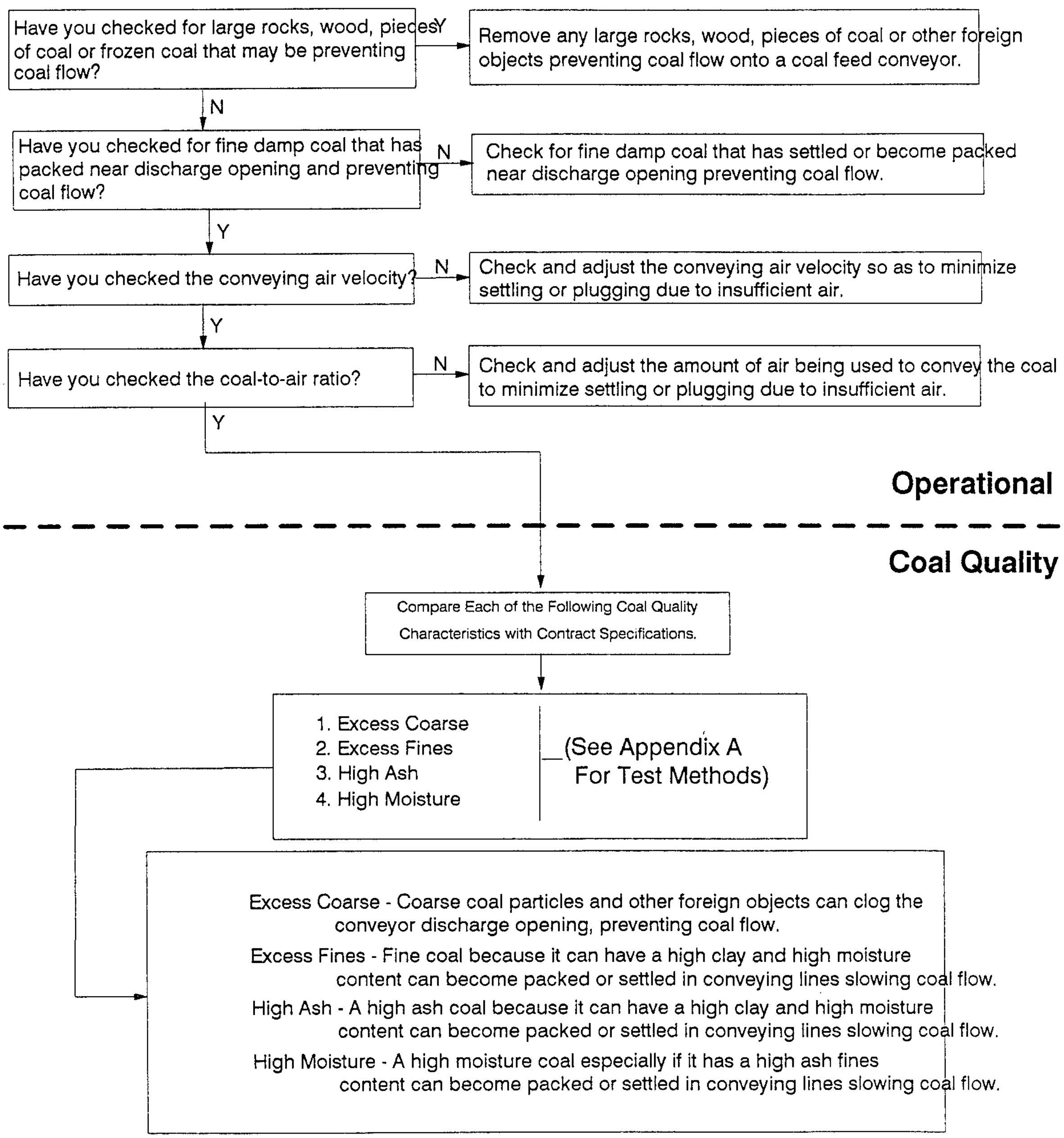


FIG4-12n/1

FIGURE 4-13: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding Of The Coal Feed Conveyor

(Pneumatic Conveyor)

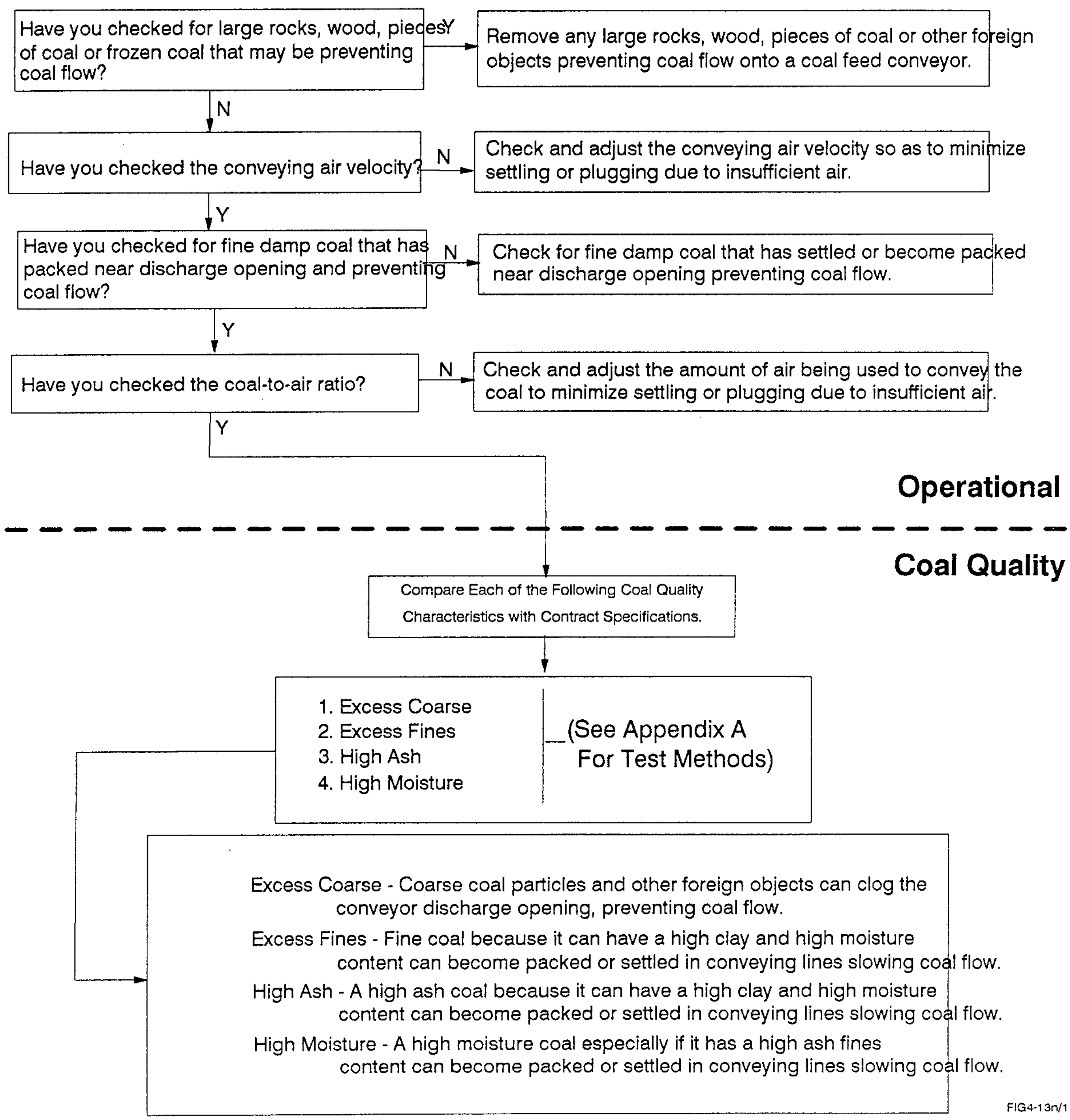


FIGURE 4-14: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

for Excess Wear In The Coal Feed Conveyor

(Pneumatic Conveyor)

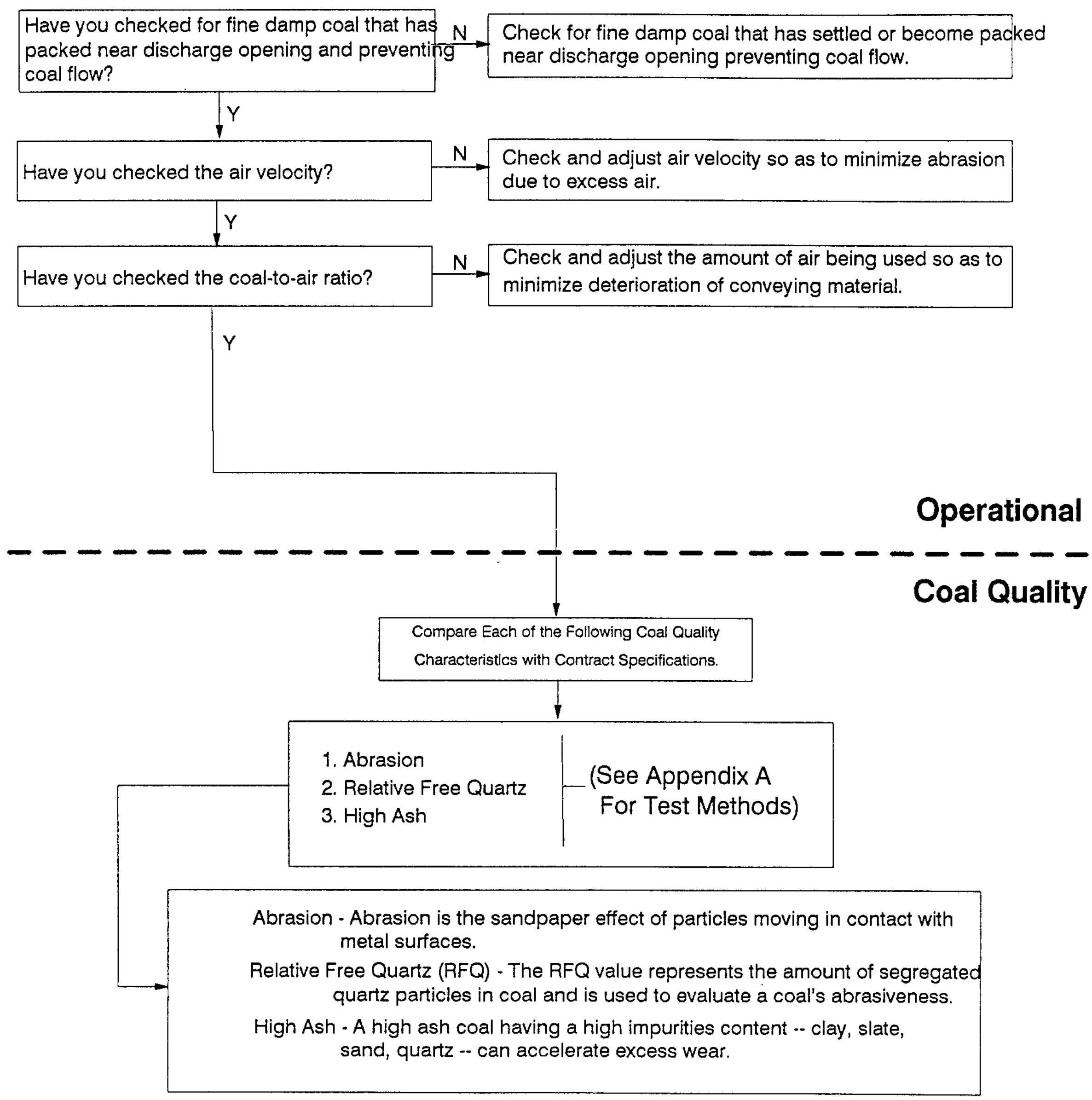


FIG4-14n/1

FIGURE 4-15: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage Of The Cyclone Separator

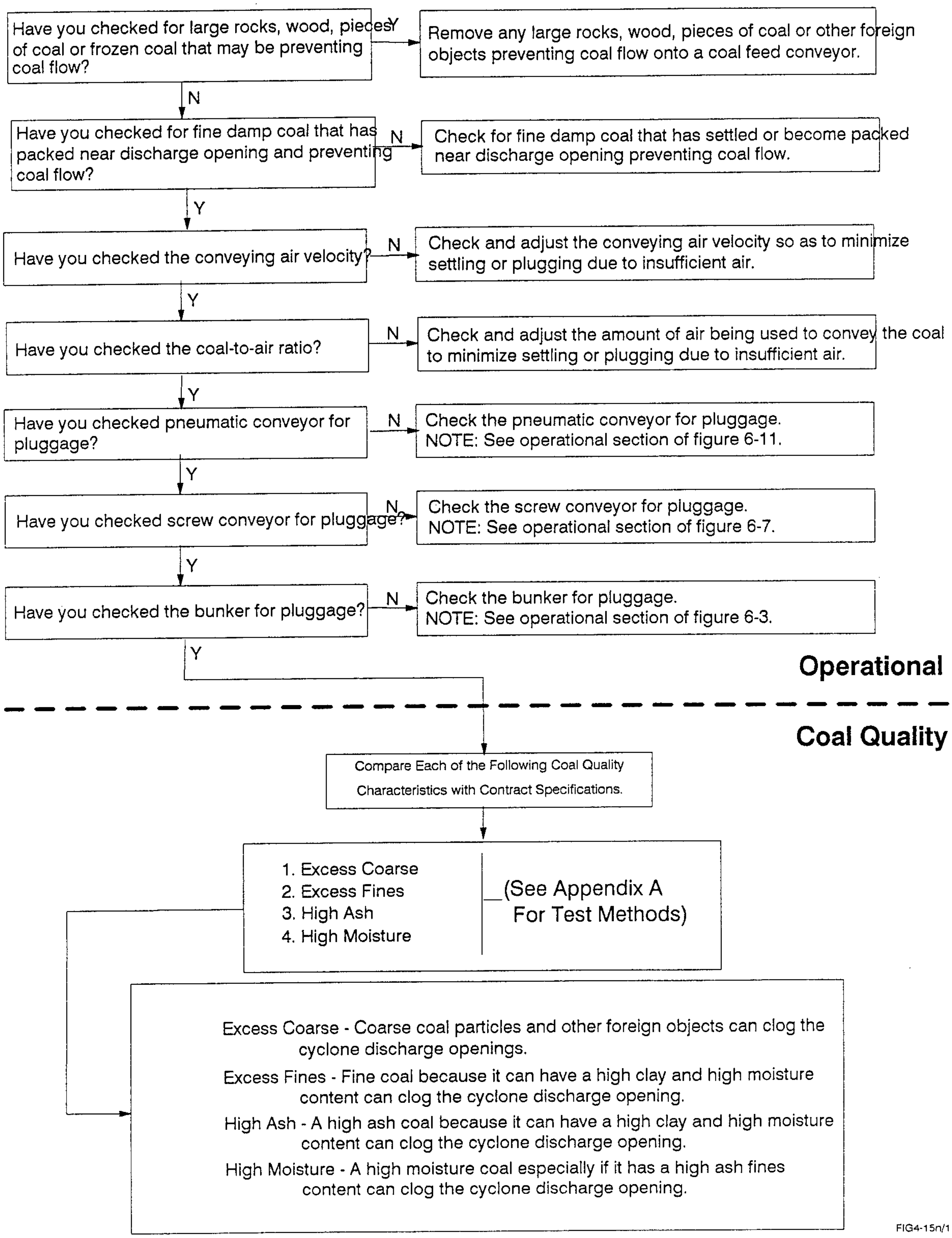


FIG4-15n/1

FIGURE 4-16: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Cyclone Separator

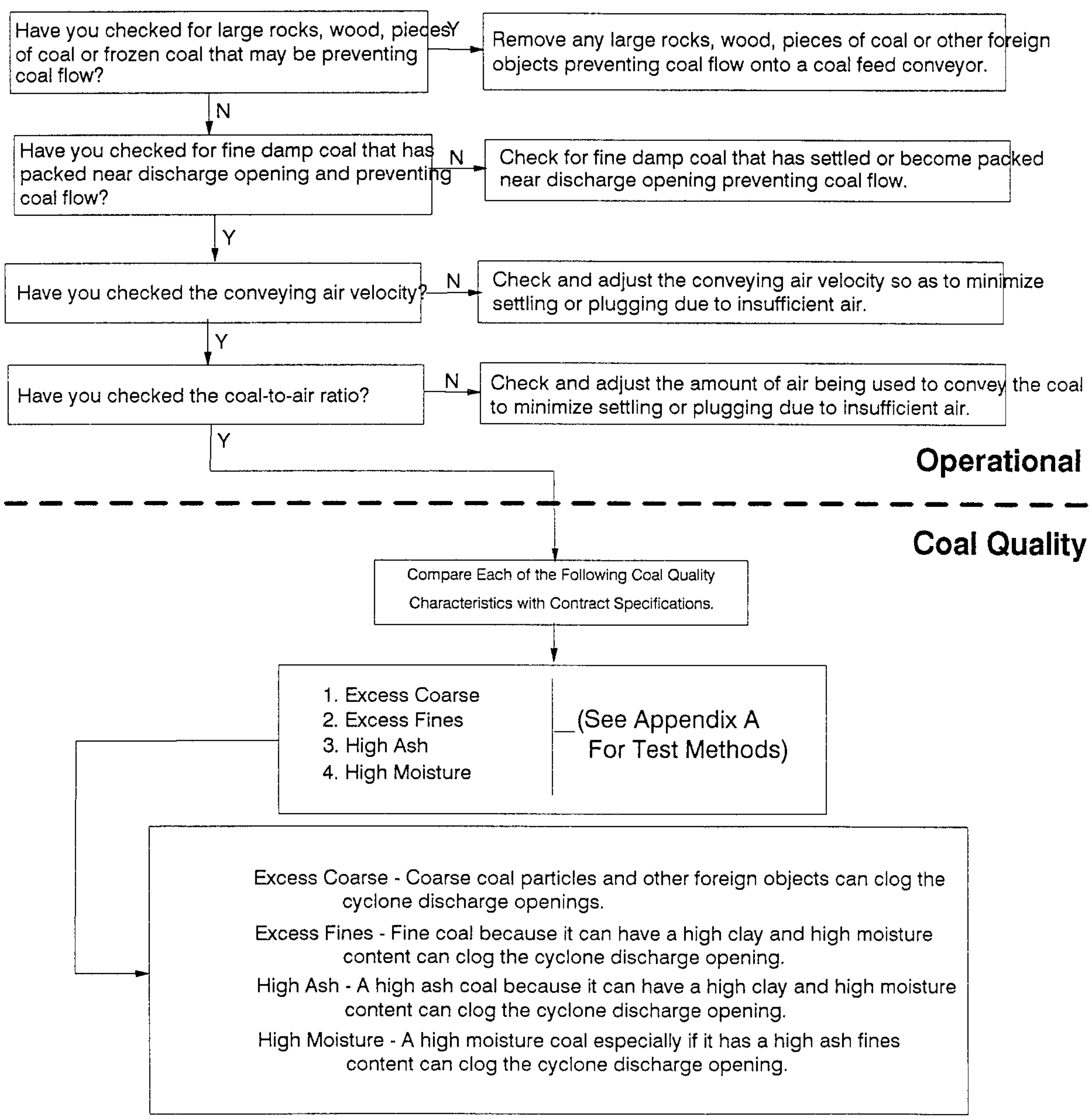


FIG4-16n/1

FIGURE 4-17: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding Of The Cyclone Separator

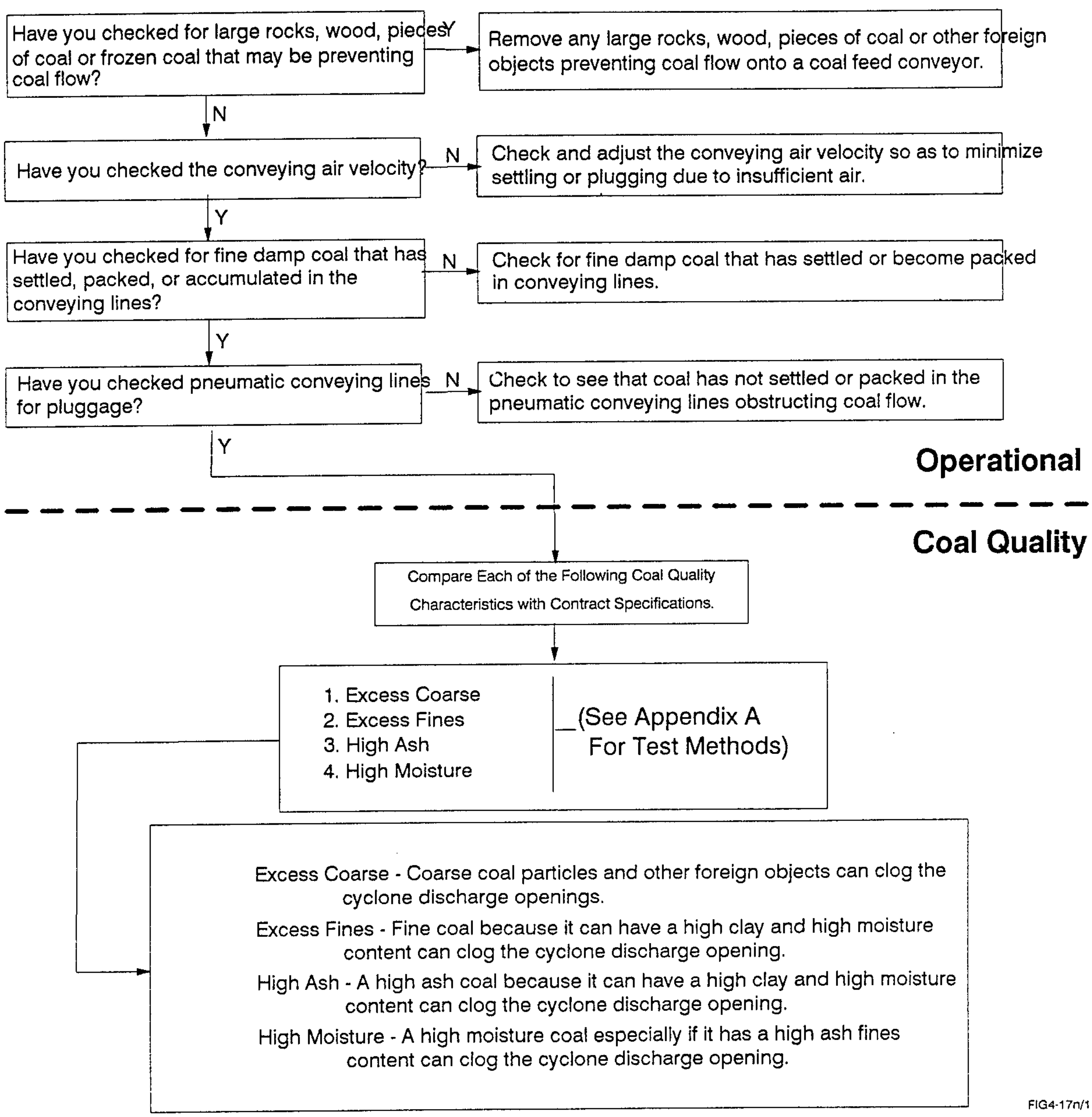
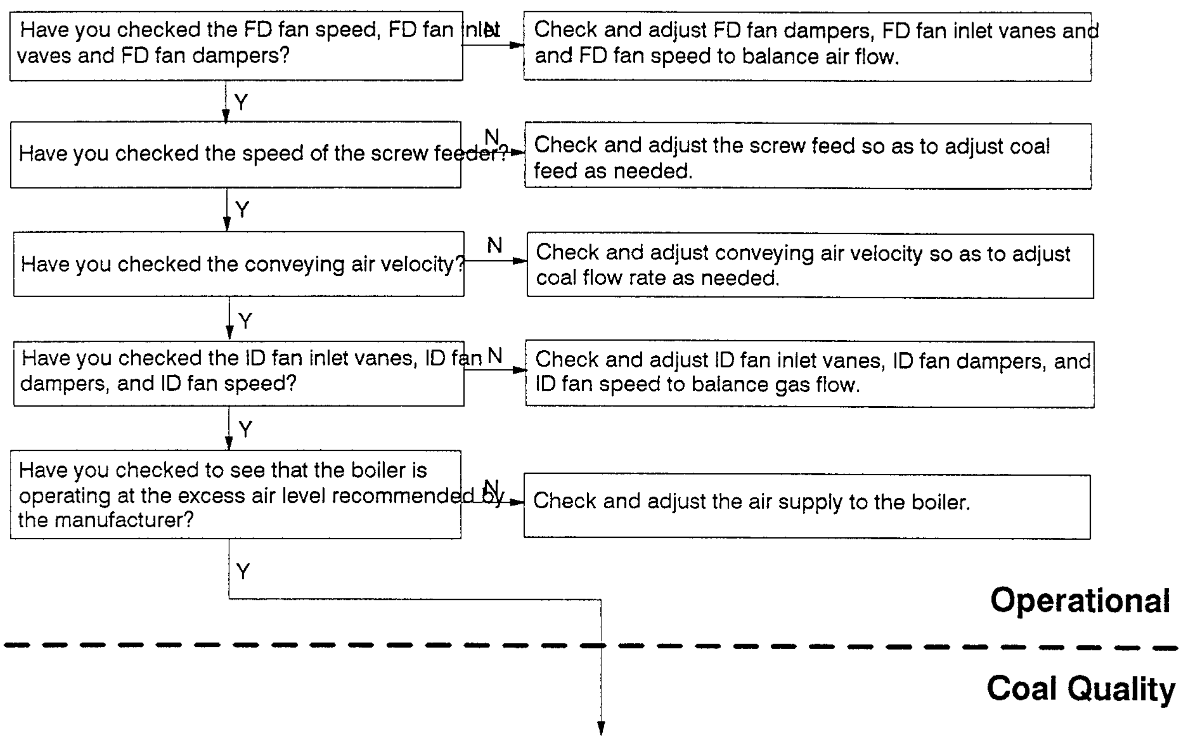


FIG4-17n/1

FIGURE 4-18: TOP FEED STATIC GRATE STOKER TROUBLE SHOOTINGLOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Boiler)



See next page for Coal Quality Section.

FIG4-18n/1

FIGURE 4-18 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Boiler)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. High ASH
5. Excess Coarse
6. Excess Fine
7. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

High Ash - If excessive ash particles can become sufficiently thick on the grate to seriously restrict air flow through the grate and fuel bed making it difficult to complete combustion.

Excess Coarse - Coarse coal tends to segregate in coal conveying equipment and hoppers causing uneven burning, an uneven ash and coal bed on the grate.

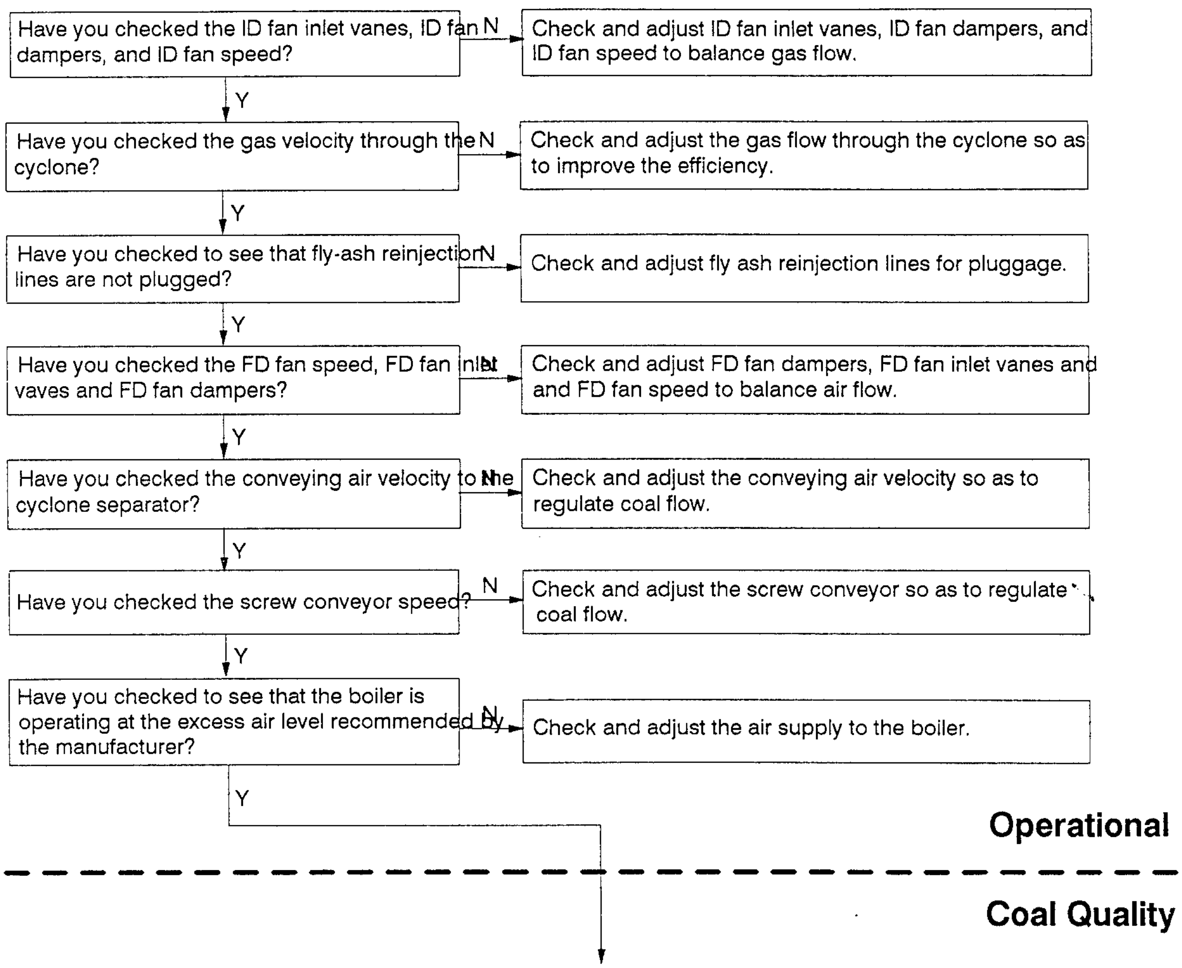
Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG4-18nb/1

FIGURE 4-19: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Reduced Boiler Efficiency



See next page for Coal Quality Section.

FIG4-19n/1

FIGURE 4-19 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Reduced Boiler Efficiency

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Volatile Matter
2. High Fixed Carbon
3. Excess Fine
4. Low Moisture

(See Appendix A For Test Methods)

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion

FIG4-19nb/1

FIGURE 4-20: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion On The Boiler Components

(Static Grate)

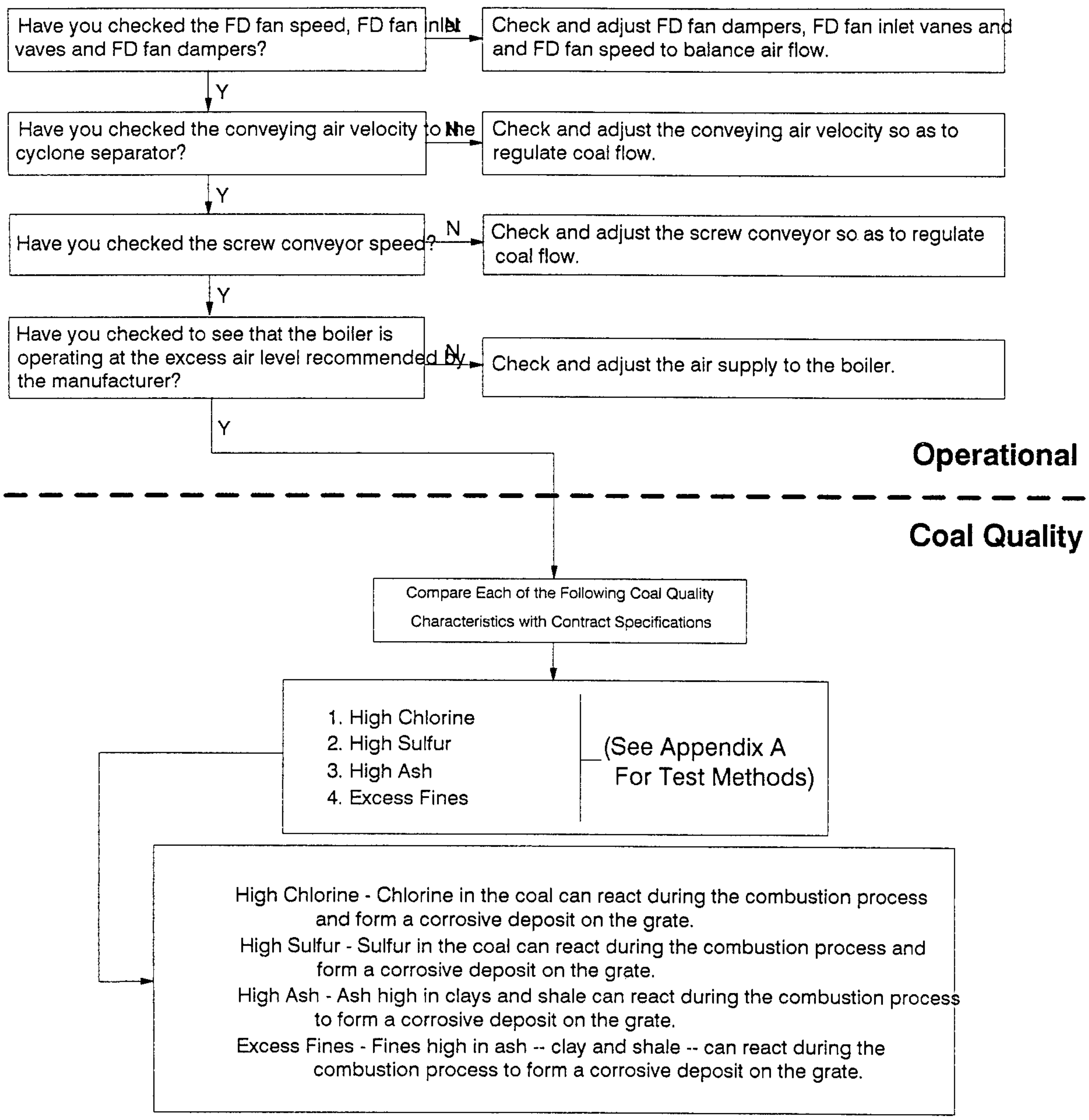


FIG4-20n/1

FIGURE 4-21: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Pressure Drop Across The Grate

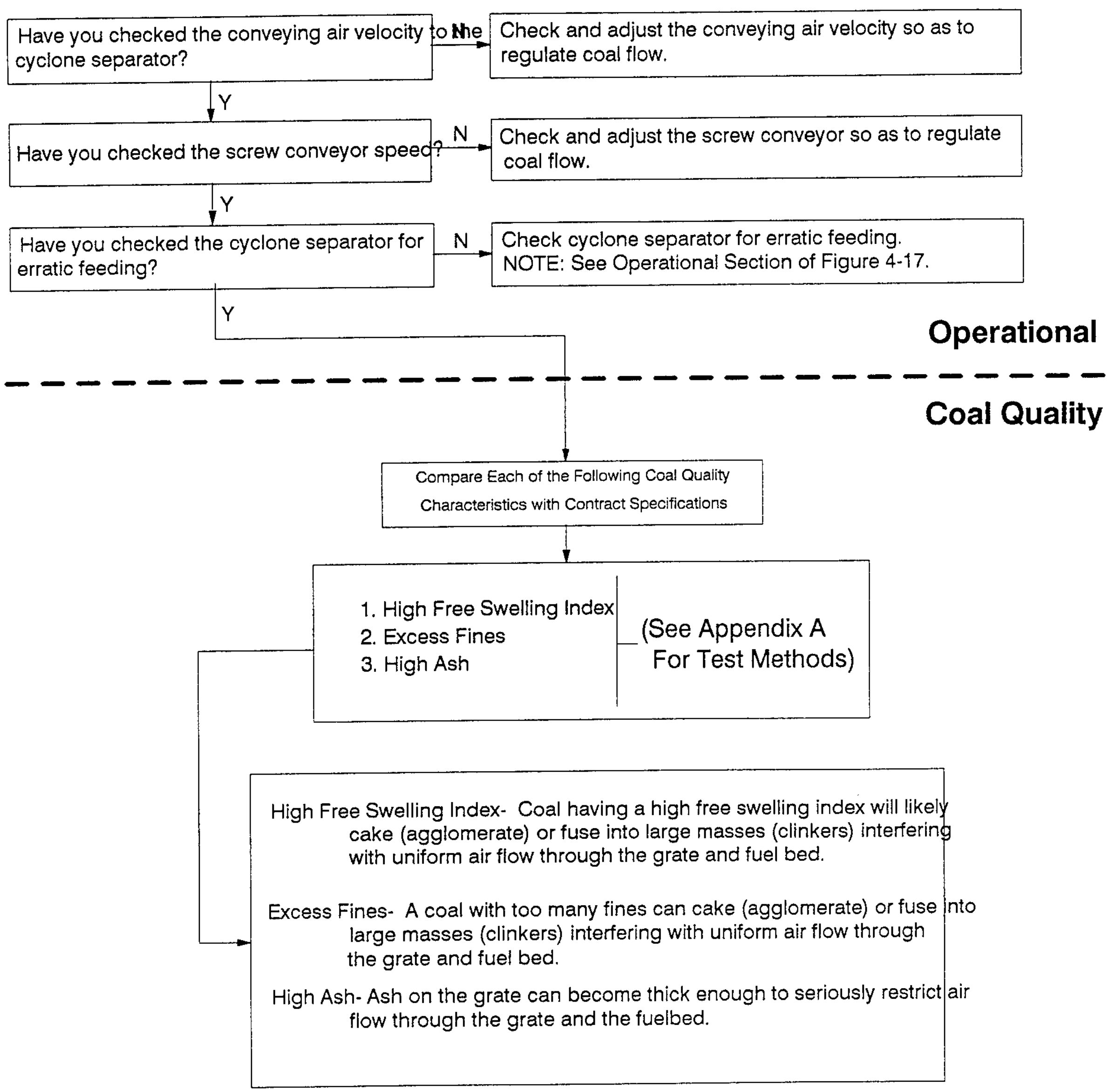


FIG4-21n/1

FIGURE 4-22: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Ash Bed On The Grate

Have you checked the conveying air velocity to the cyclone separator? — N → Check and adjust the conveying air velocity so as to regulate coal flow.

↓ Y

Have you checked the screw conveyor speed? — N → Check and adjust the screw conveyor so as to regulate coal flow.

↓ Y

Have you checked the FD fan speed, FD fan inlet vaves and FD fan dampers? — N → Check and adjust FD fan dampers, FD fan inlet vanes and and FD fan speed to balance air flow.

↓ Y

Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer? — N → Check and adjust the air supply to the boiler.

↓ Y

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Excess Coarse
2. Excess Fines
3. High Moisture
4. High Free Swelling Index

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal tends to segregate in the coal conveying equipment and in the hopper causing uneven feeding, uneven burning and an uneven ash coal bed.

Excess Fines - A high fines coal can segregate in one area of the grate causing uneven burning.

High Moisture - Wet coal may clog in chutes or hopper causing uneven or erratic feeding, uneven burning and an uneven ash or coal bed.

High Free Swelling Index(FSI) - Coking coals -- the FSI is an indication of the coking tendencies of coal -- tend to swell and produce a deep fuel bed.

FIG4-22n/1

FIGURE 4-23: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Coal Bed On The Grate

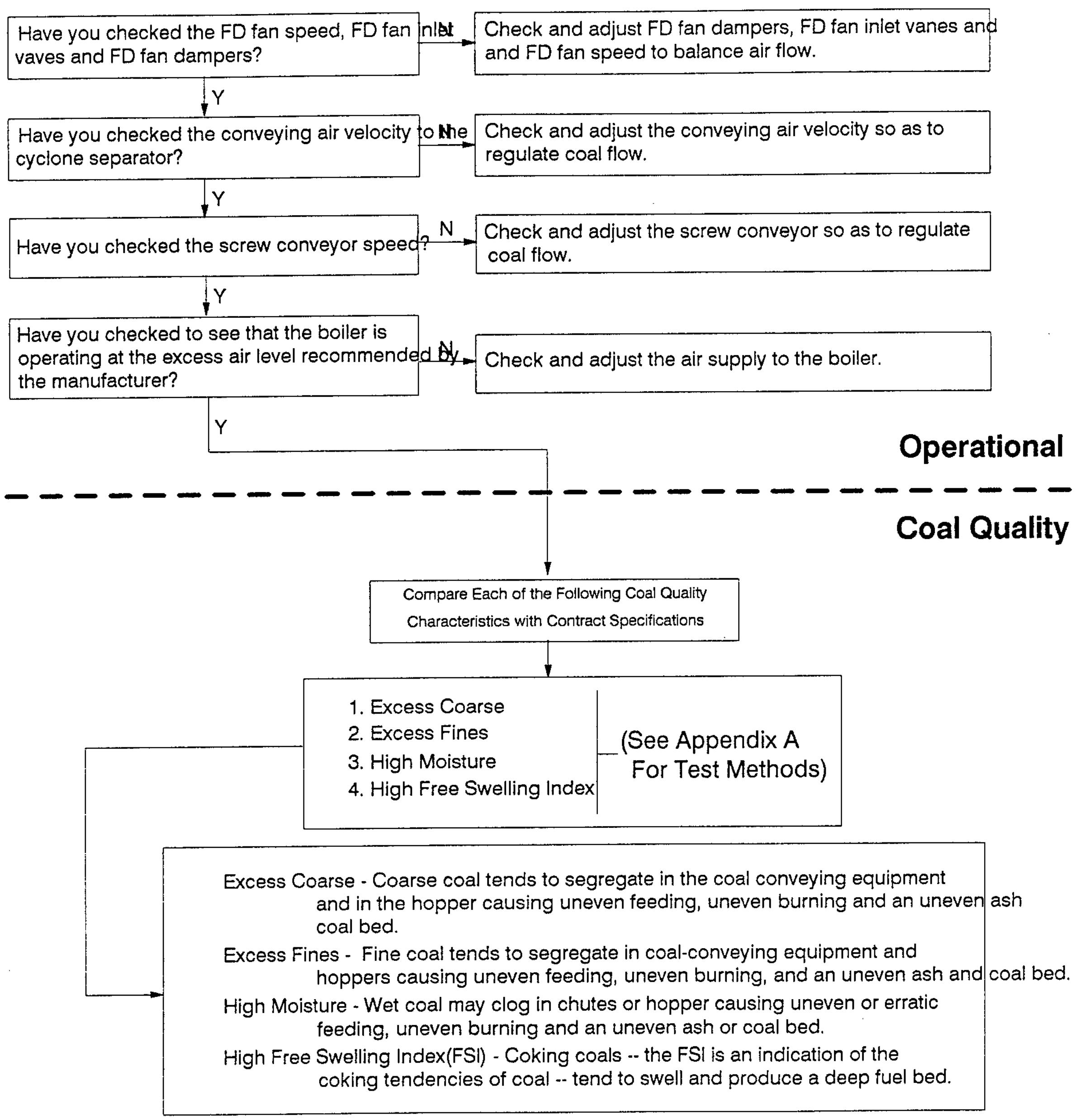


FIG4-23n/1

FIGURE 4-24: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Uneven Coal Burning On The Grate

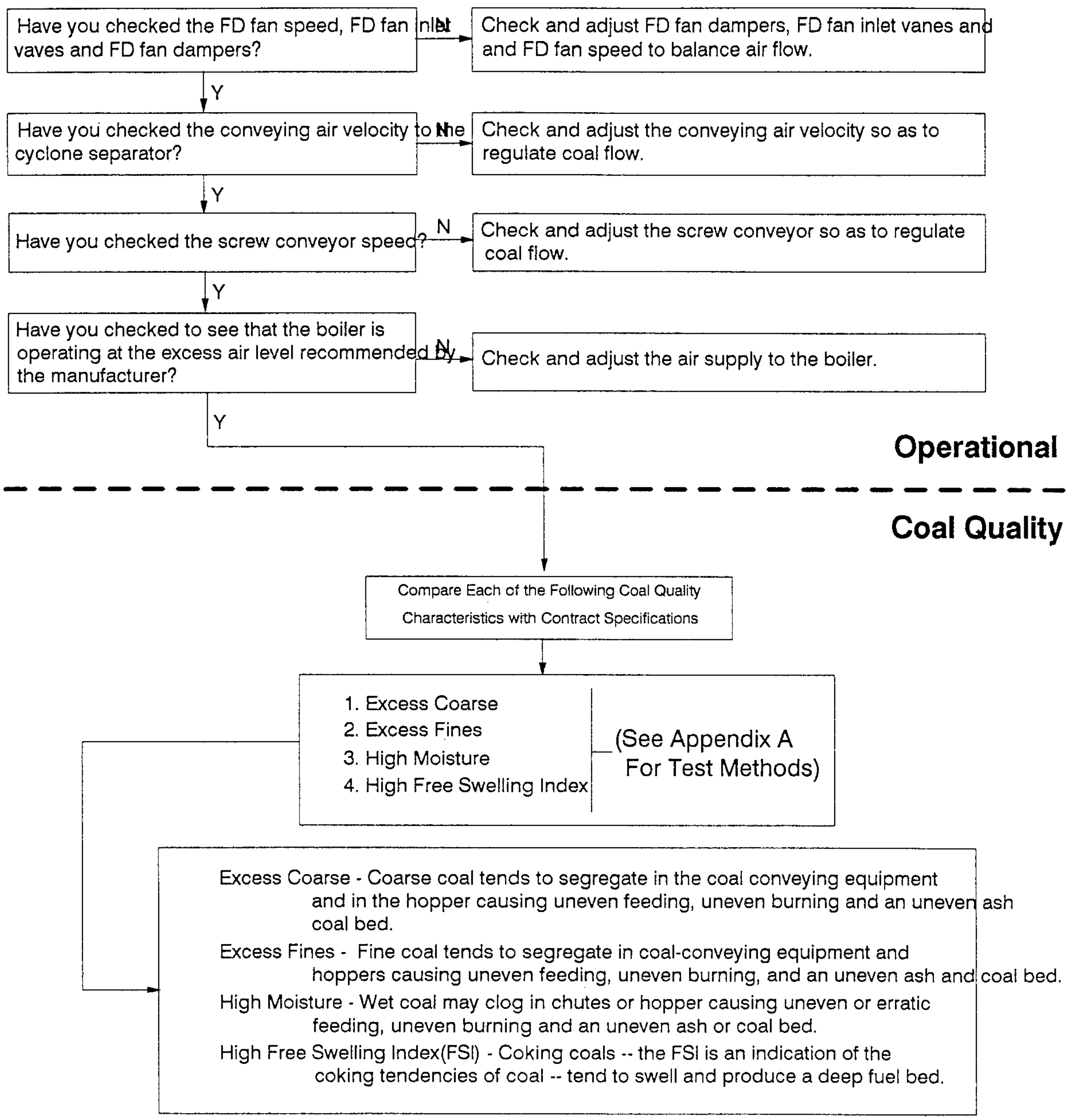


FIG4-24n/1

FIGURE 4-25: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Warped, Burnt and Cracked Grates

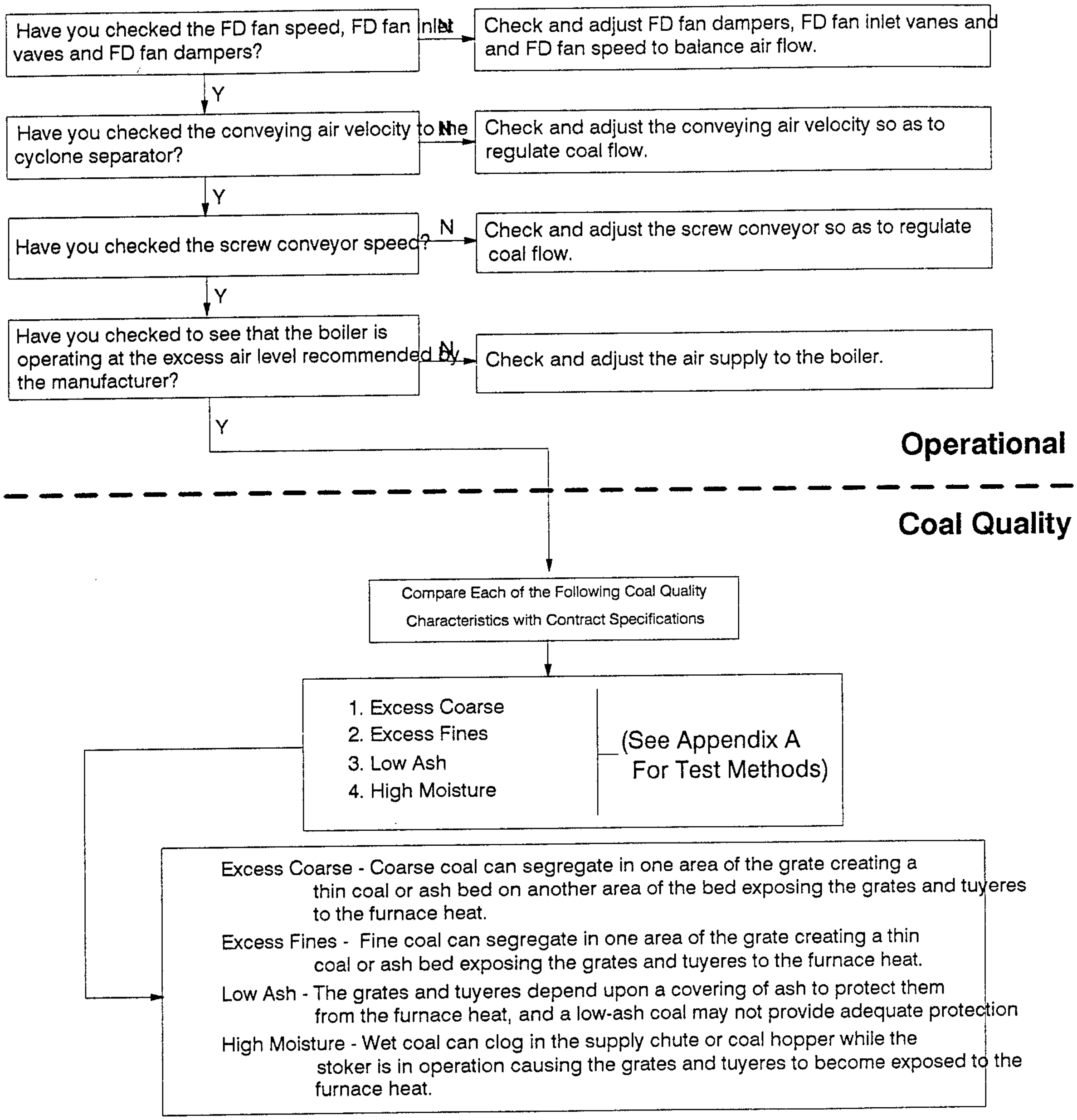


FIG4-25n/1

FIGURE 4-26: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers On The Grate

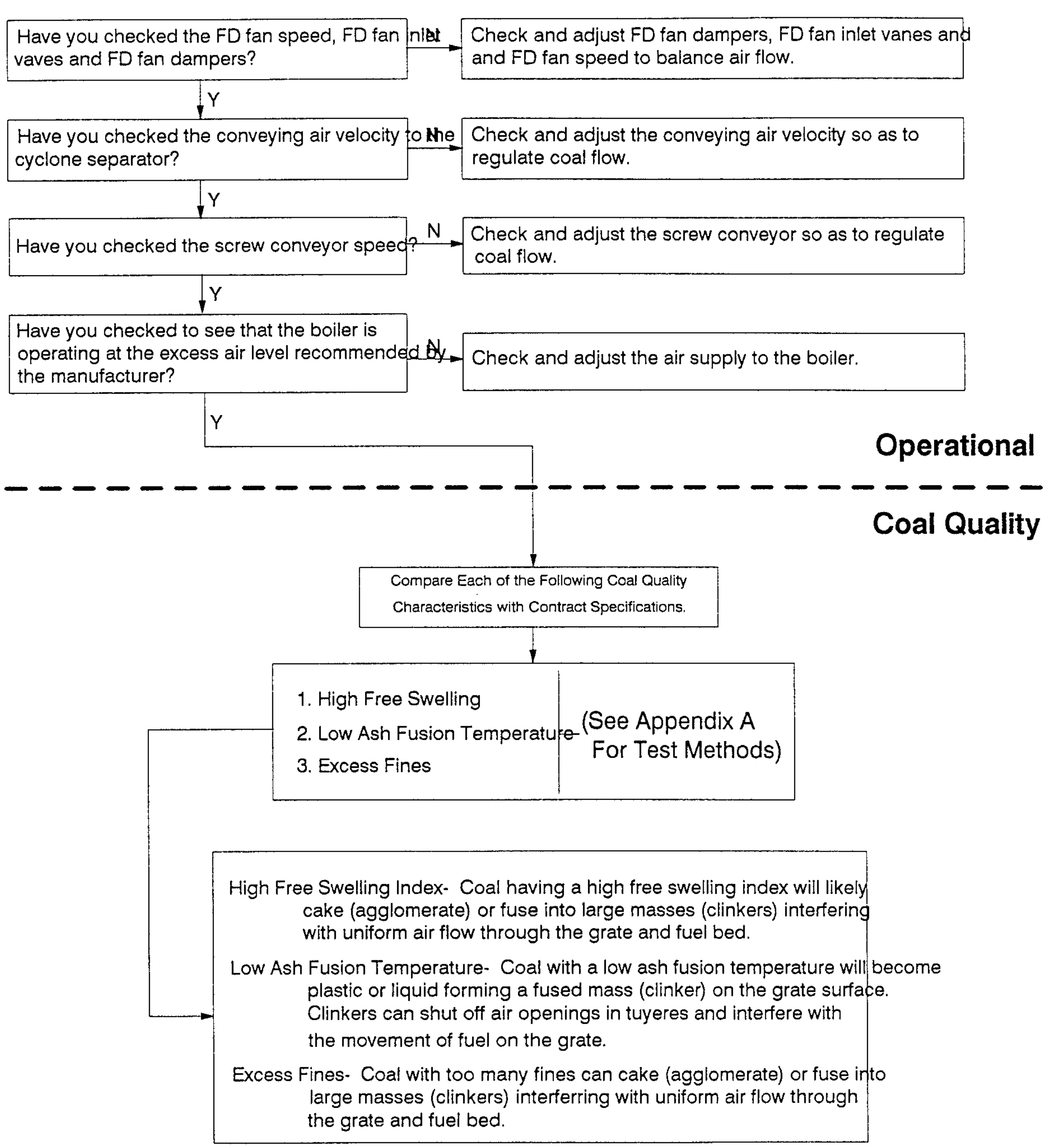


FIG4-26n/1

FIGURE 4-27: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout On The Grate

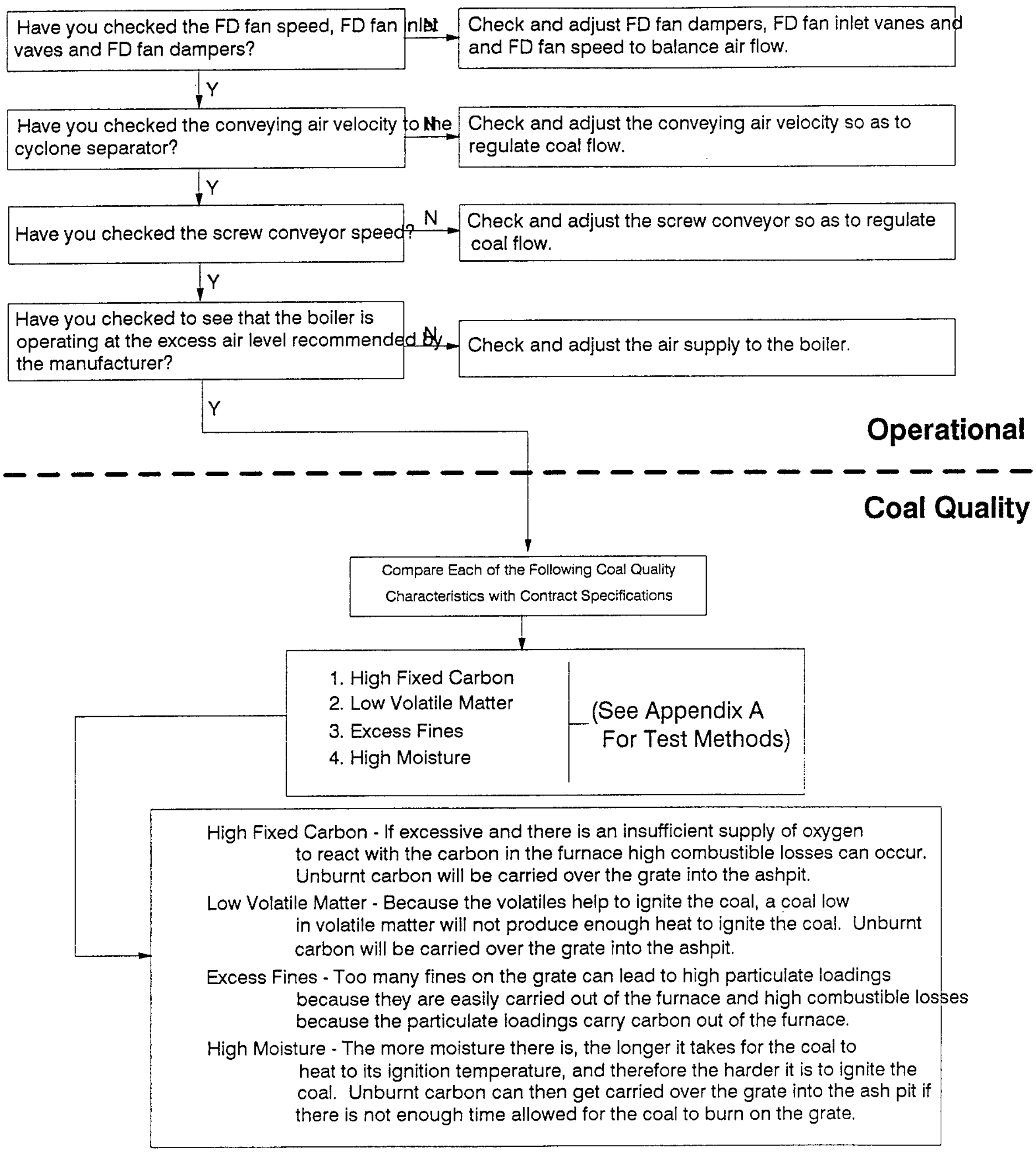


FIG4-27n/1

FIGURE 4-28: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Refractory Surfaces

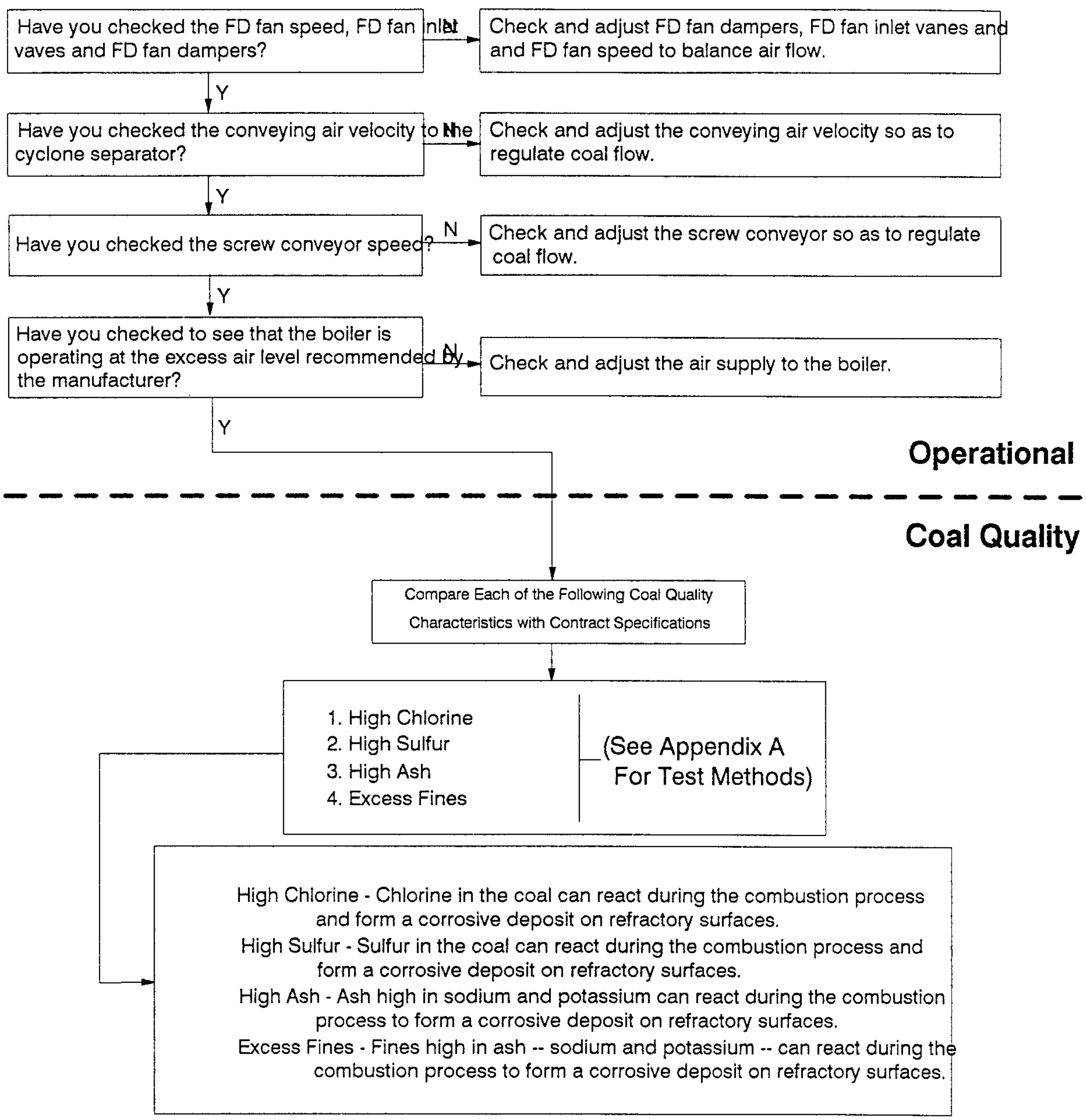


FIG4-28n/1

FIGURE 4-29: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of Refractory Surfaces

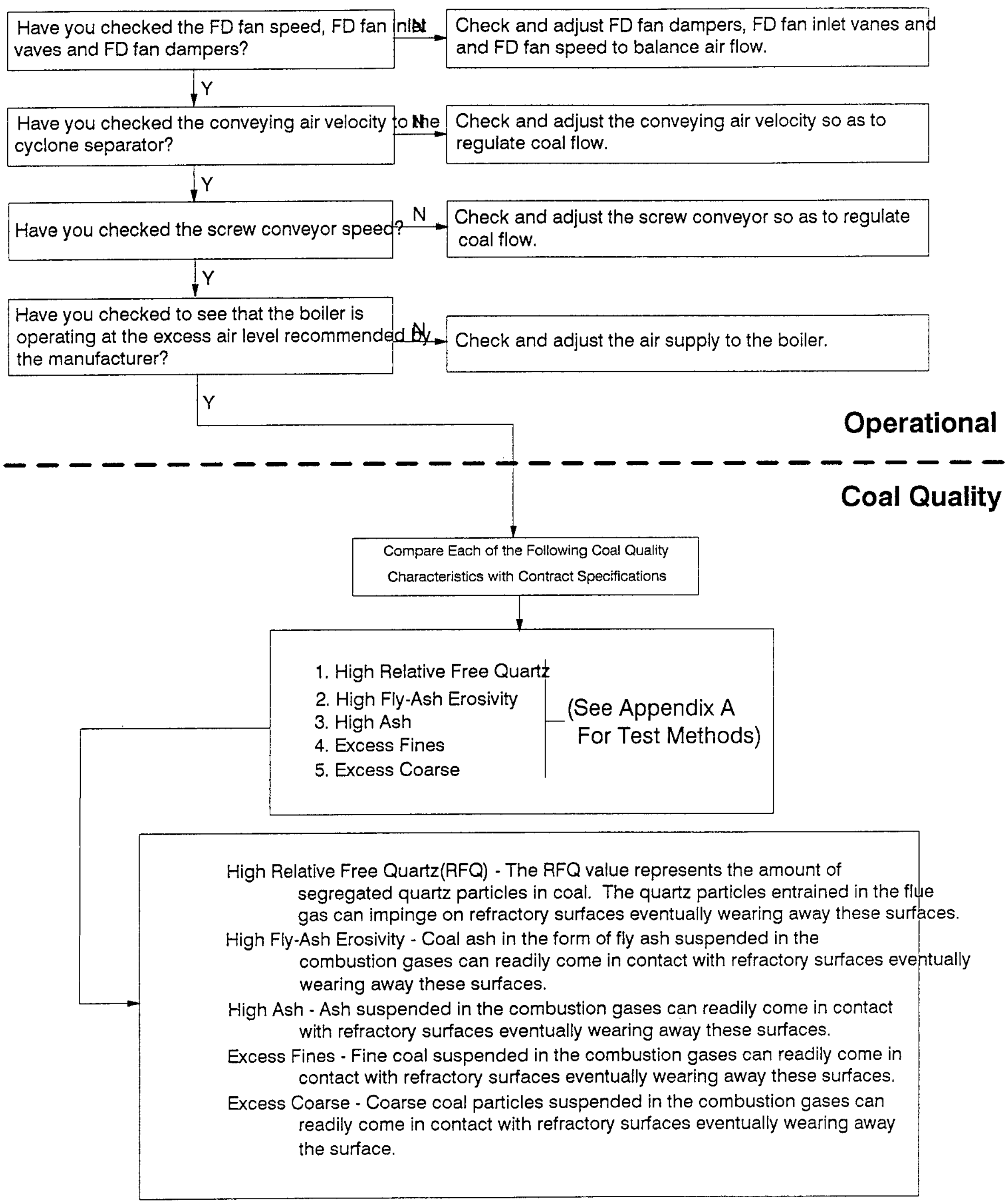


FIG4-29n/1

FIGURE 4-30: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging/Spalling Of Refractory Surfaces

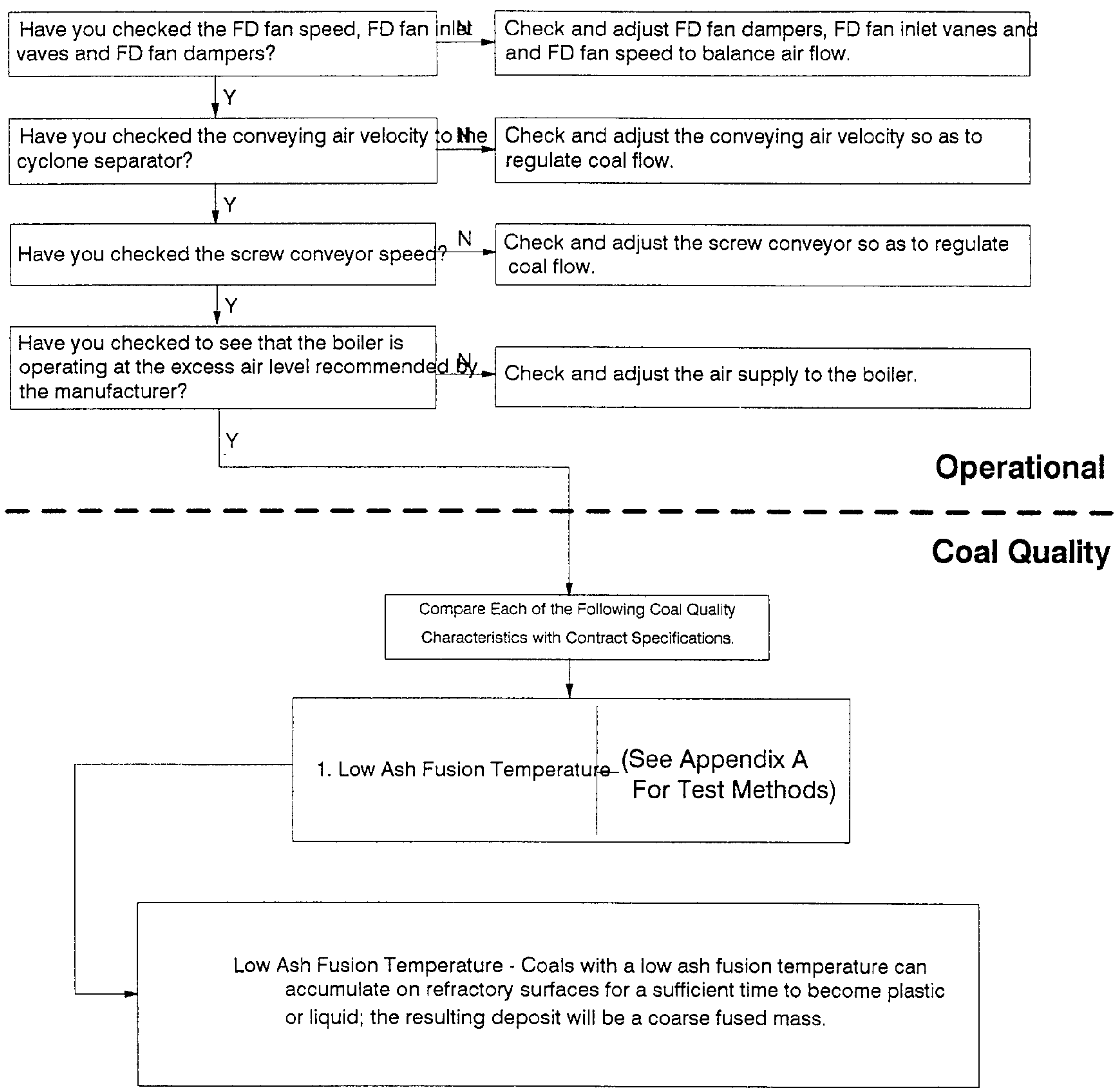


FIG4-30n/1

FIGURE 4-31: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Heat Transfer Surfaces (Boiler Tubes And Water Walls)

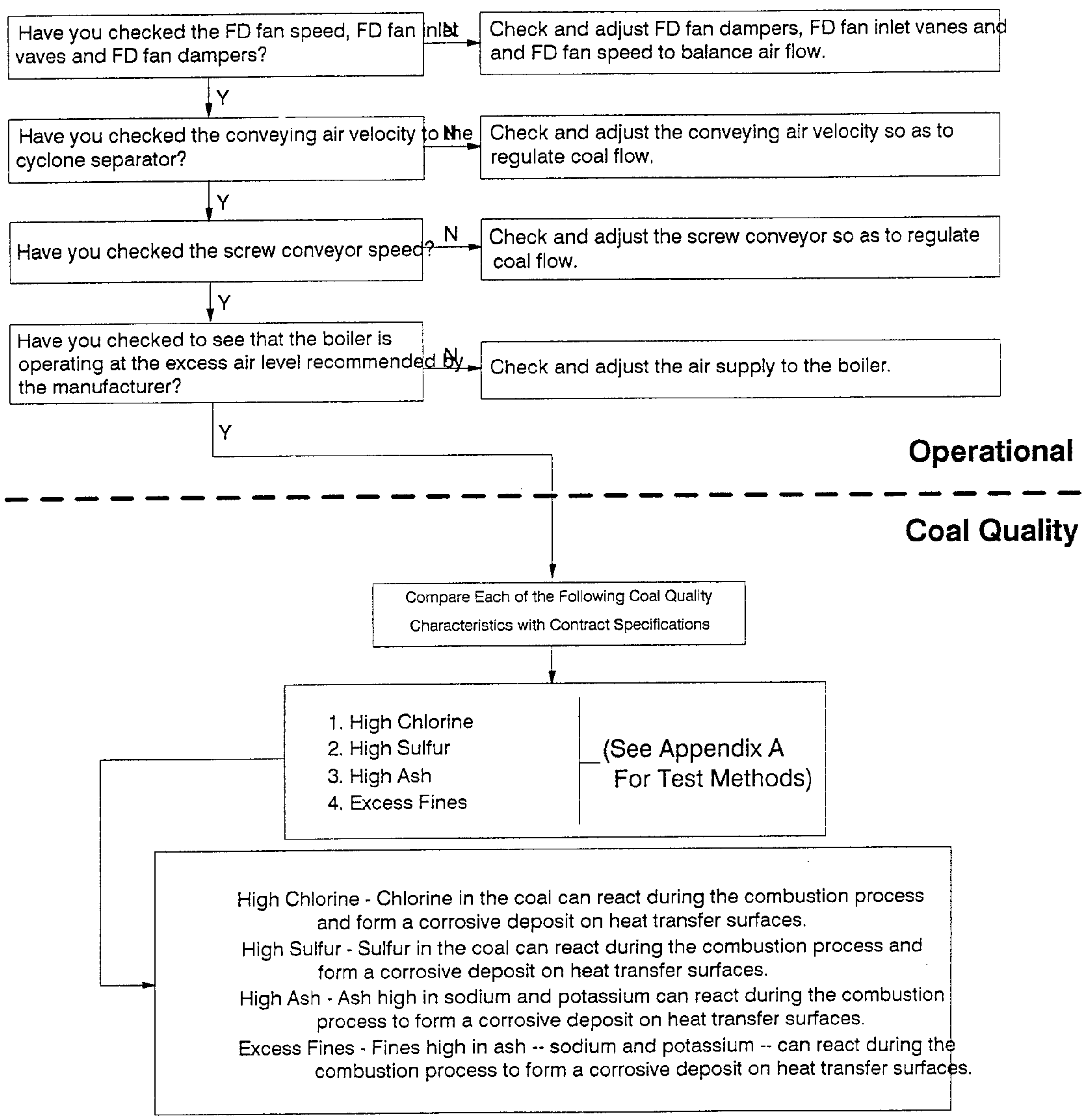


FIG4-31n/1

FIGURE 4-32: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Heat Transfer Surfaces (Boiler Tubes And Water Walls)

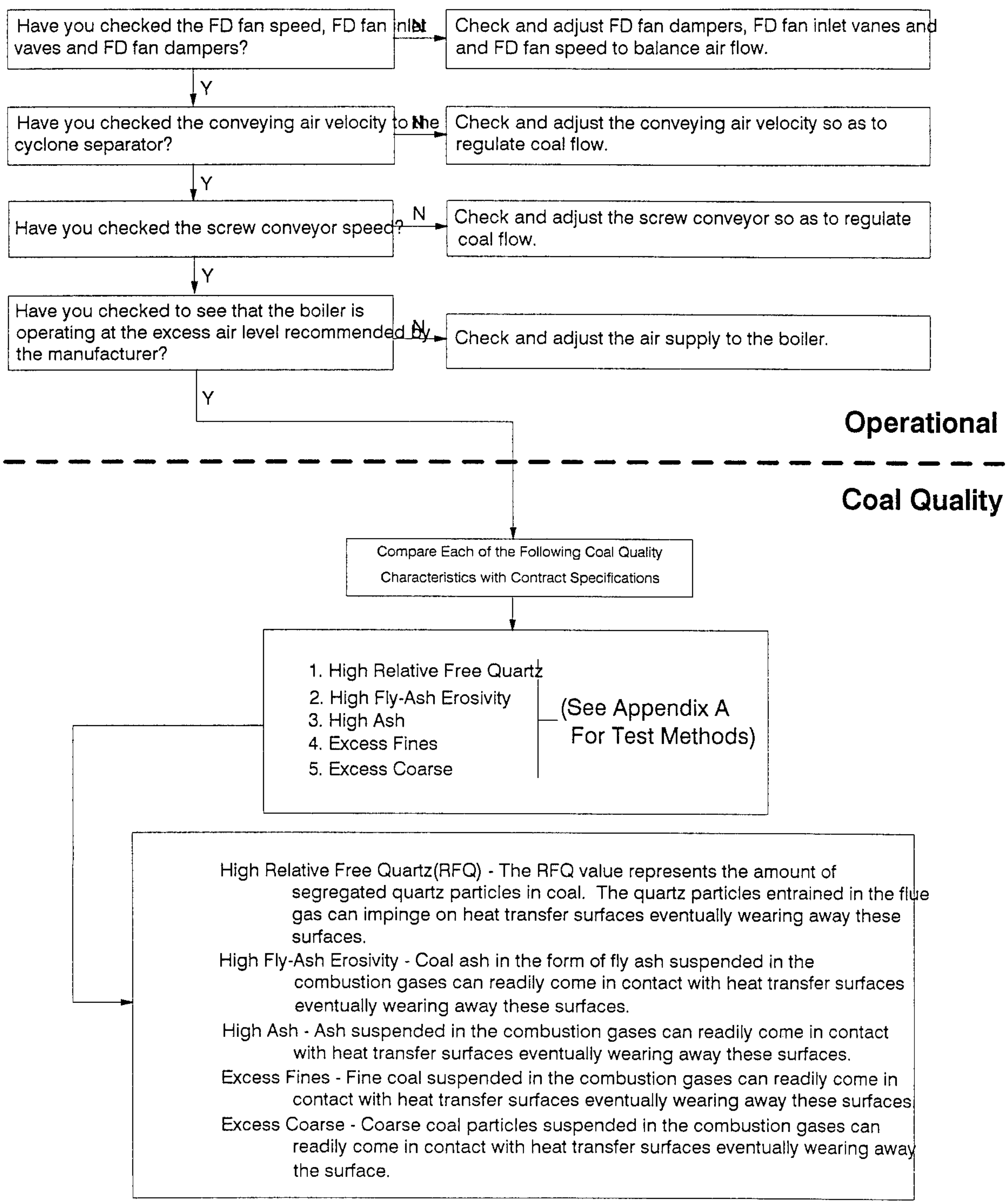


FIG4-32n/1

FIGURE 4-33: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging/Spalling Of The Heat Transfer Surfaces (Boiler Tubes And Water Walls)

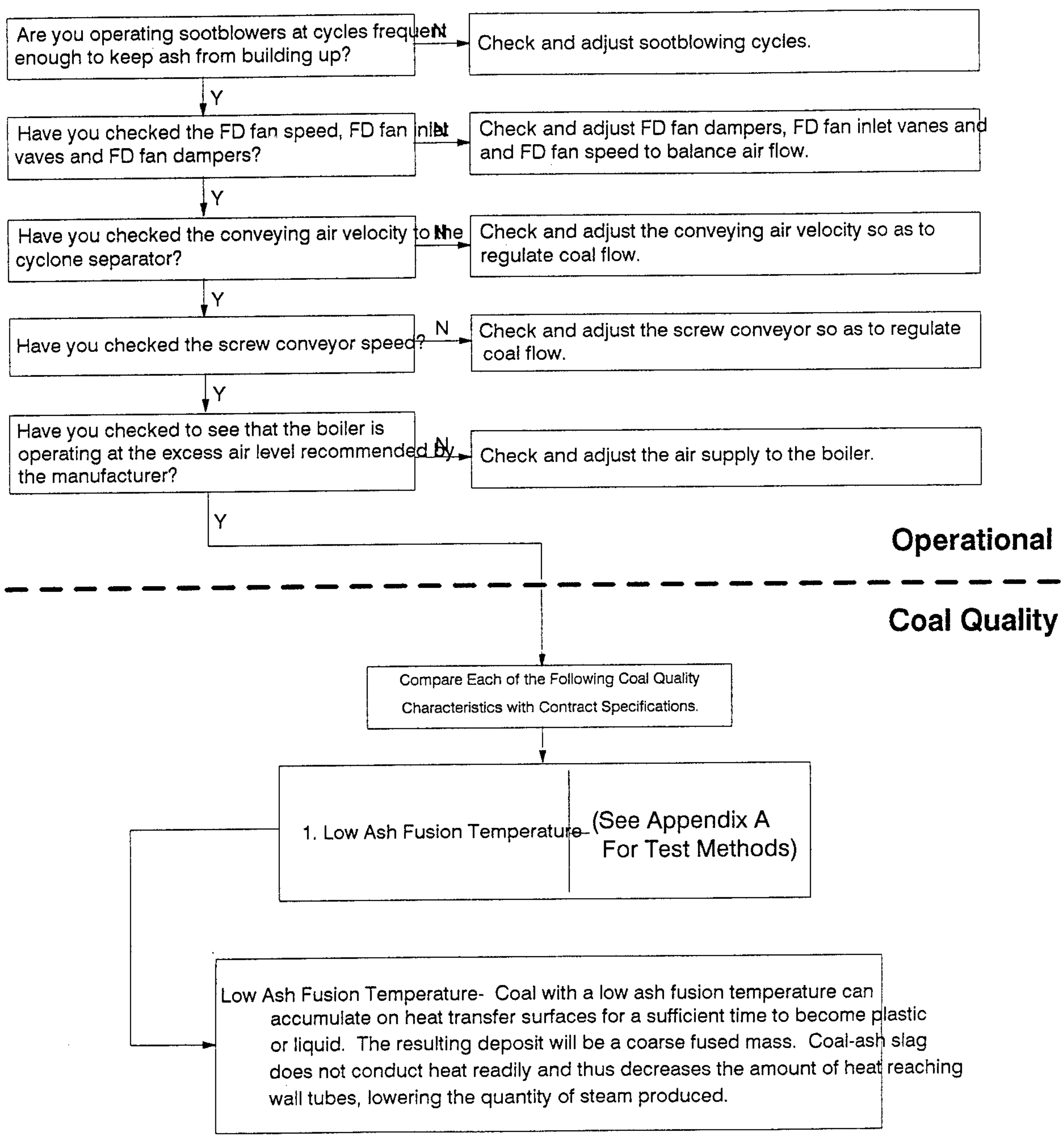


FIG4-33n/1

FIGURE 4-34: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of The Heat Transfer Surfaces (Boiler Tubes And Water Walls)

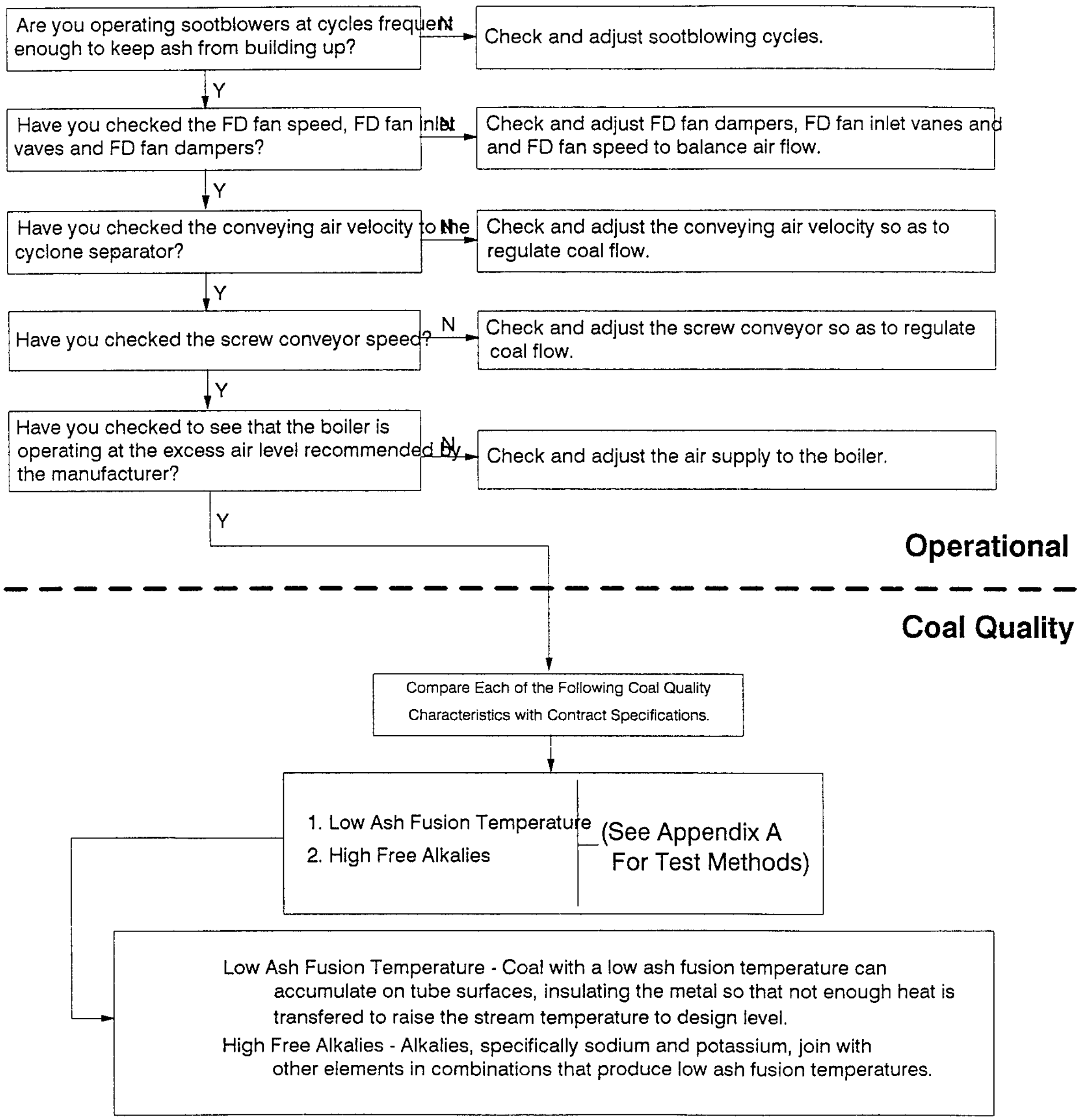


FIG4-34n/1

FIGURE 4-35: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Baffles

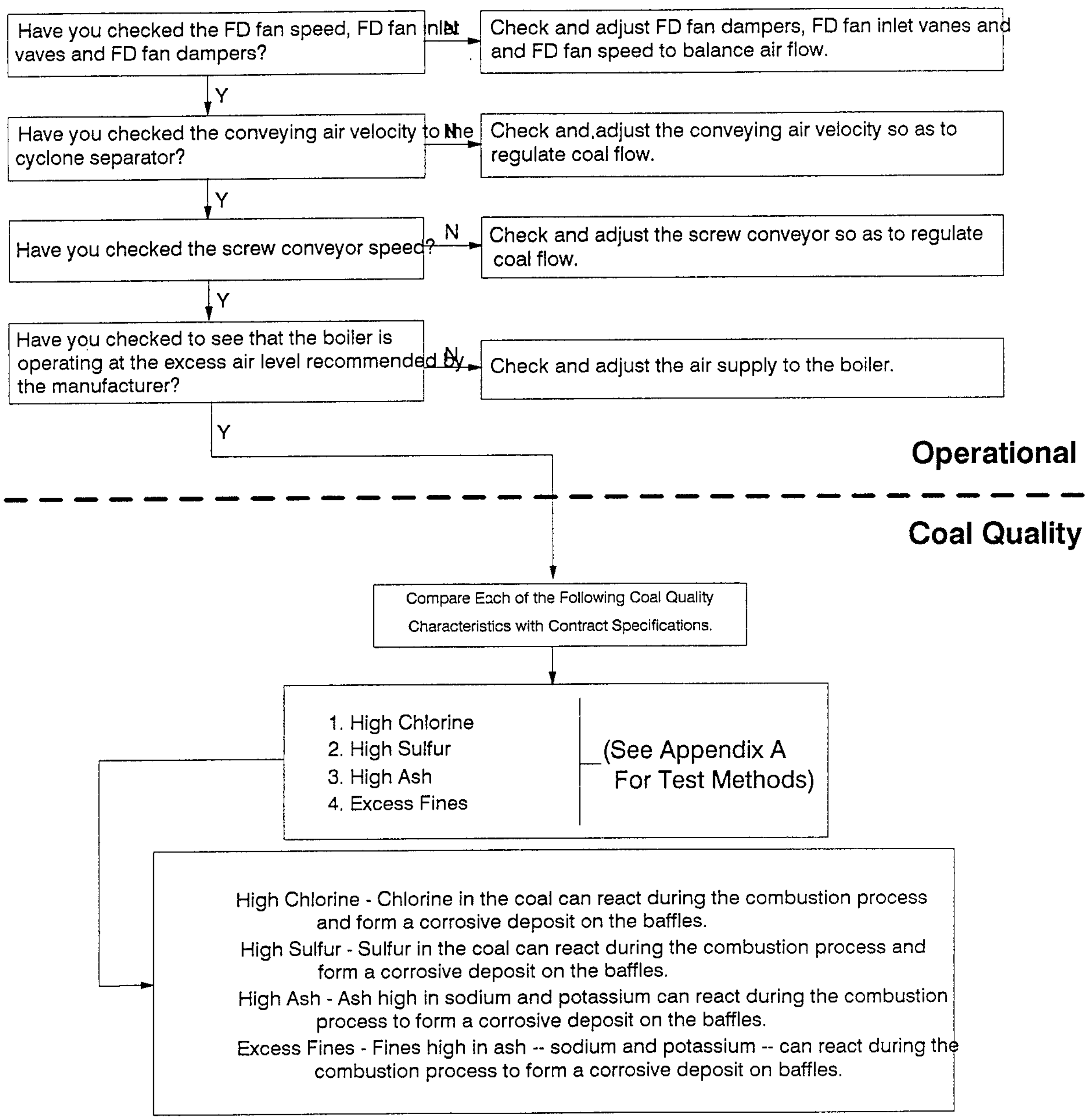


FIG4-35n/1

FIGURE 4-36: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Baffles

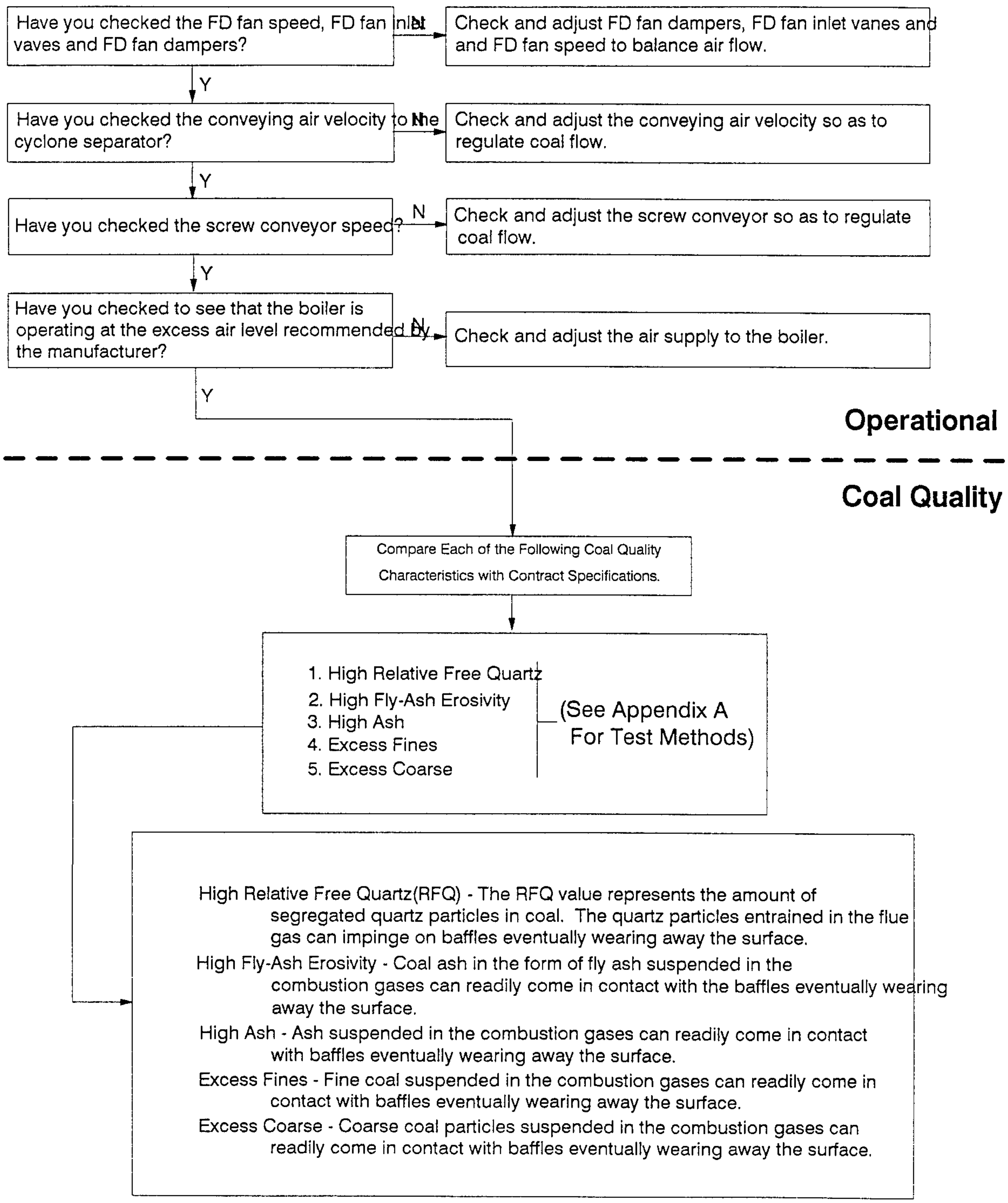


FIG4-36n/1

FIGURE 4-37: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of The Heat Transfer Surfaces (Baffles)

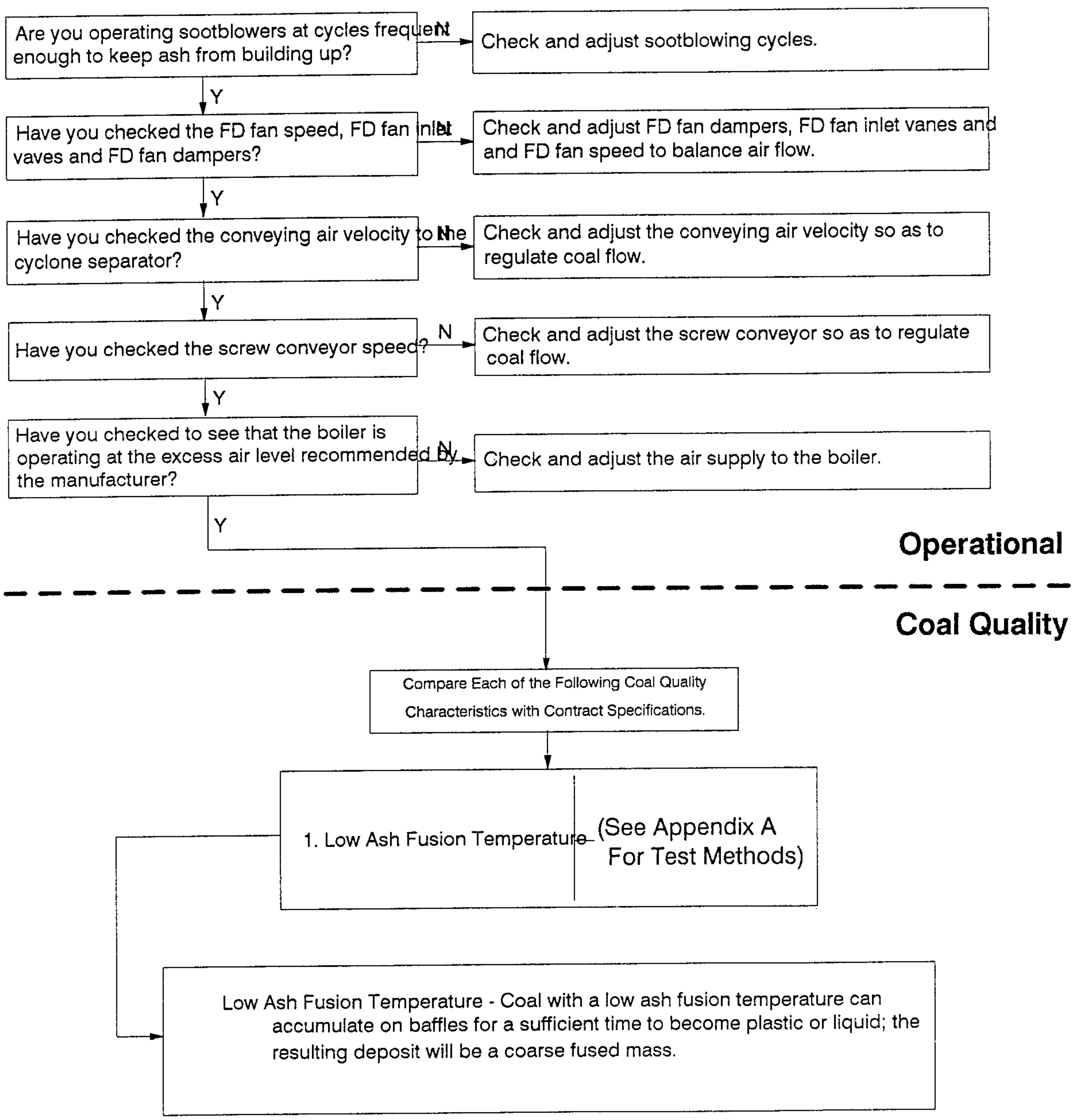


FIG4-37n/1

FIGURE 4-38: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of The Heat Transfer Surfaces (Baffles)

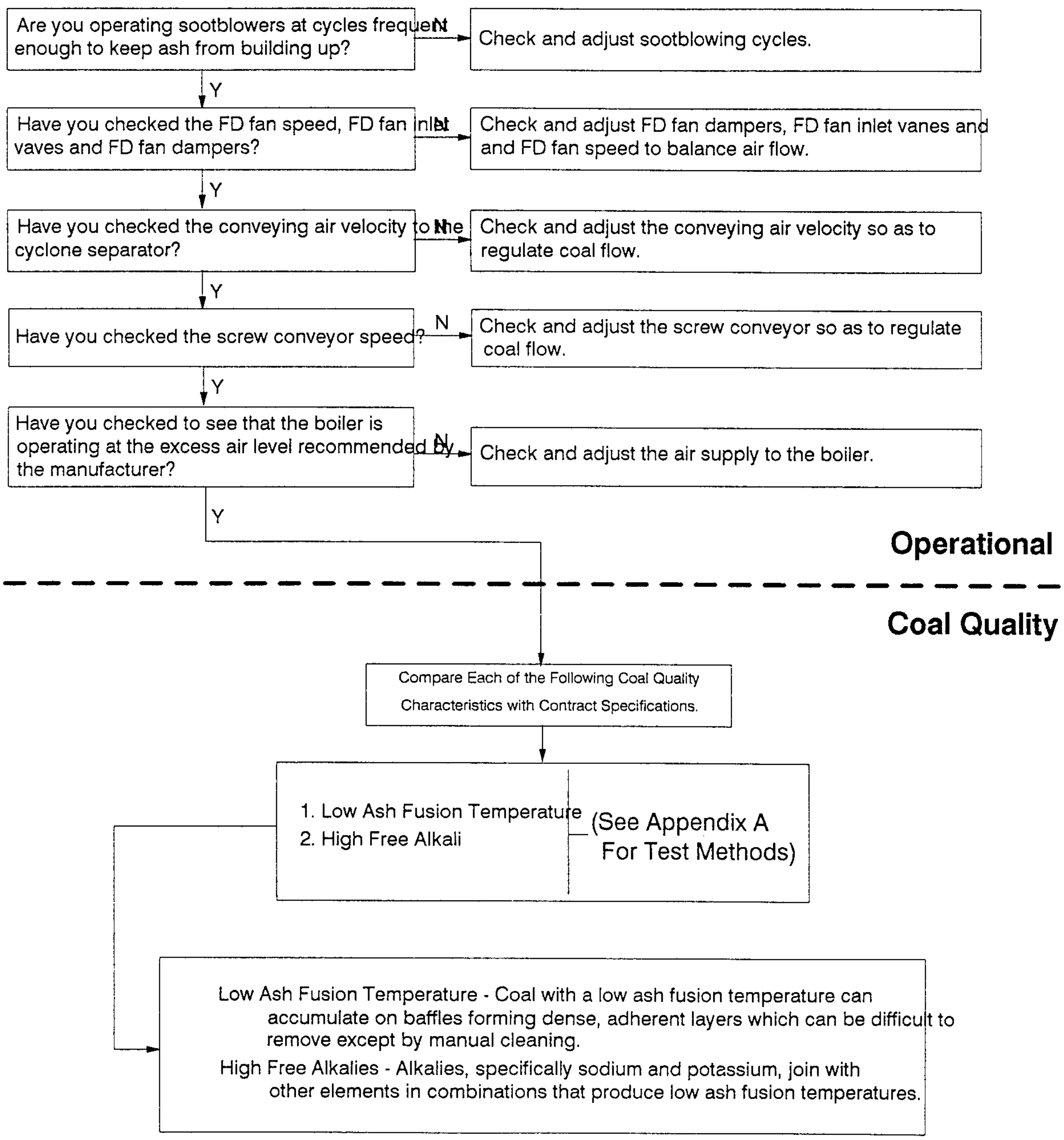


FIG4-38n/1

FIGURE 4-39: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load
(Forced Draft Fan)

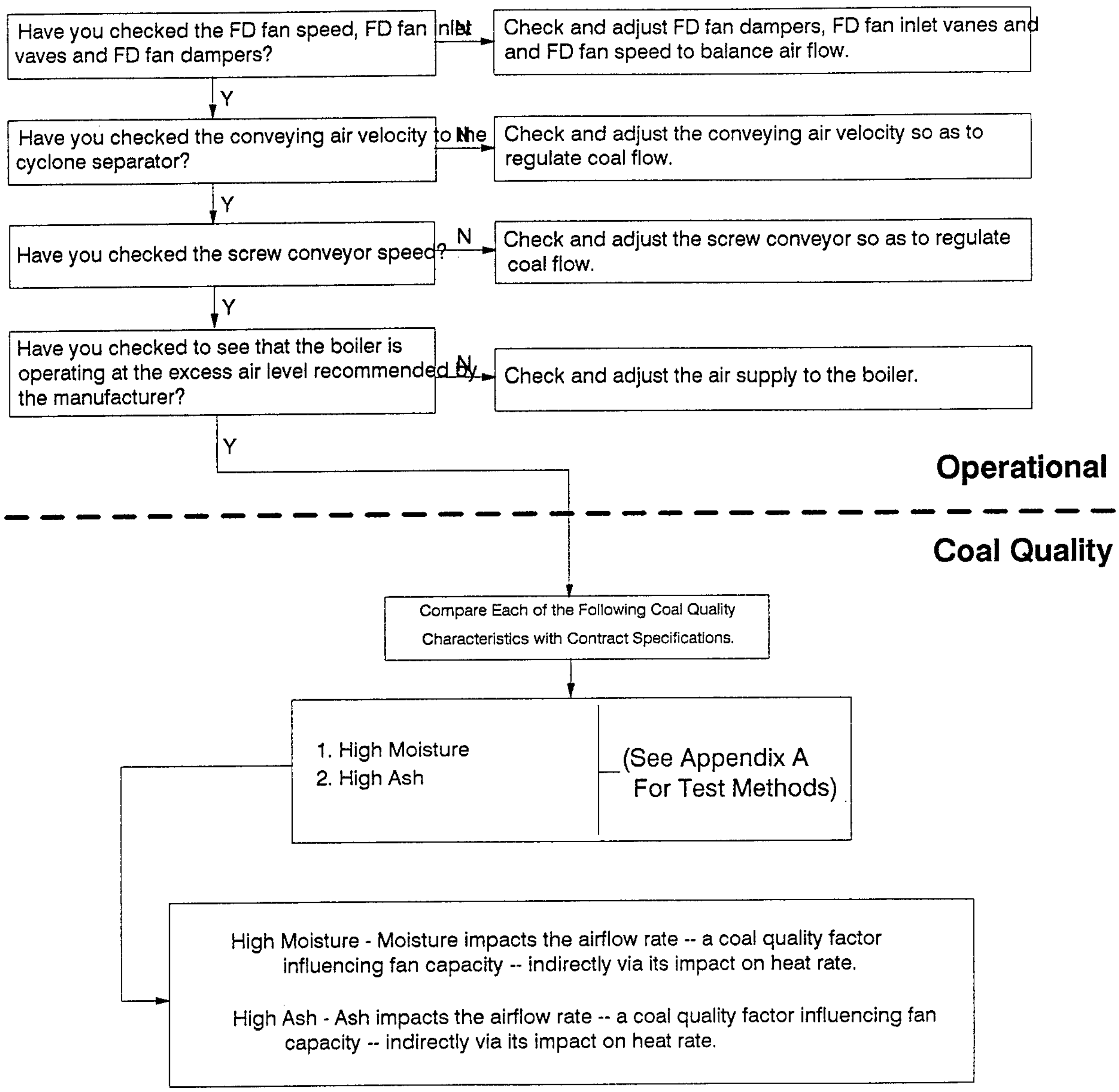


FIG4-39n/1

FIGURE 4-40: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Forced Draft Fan

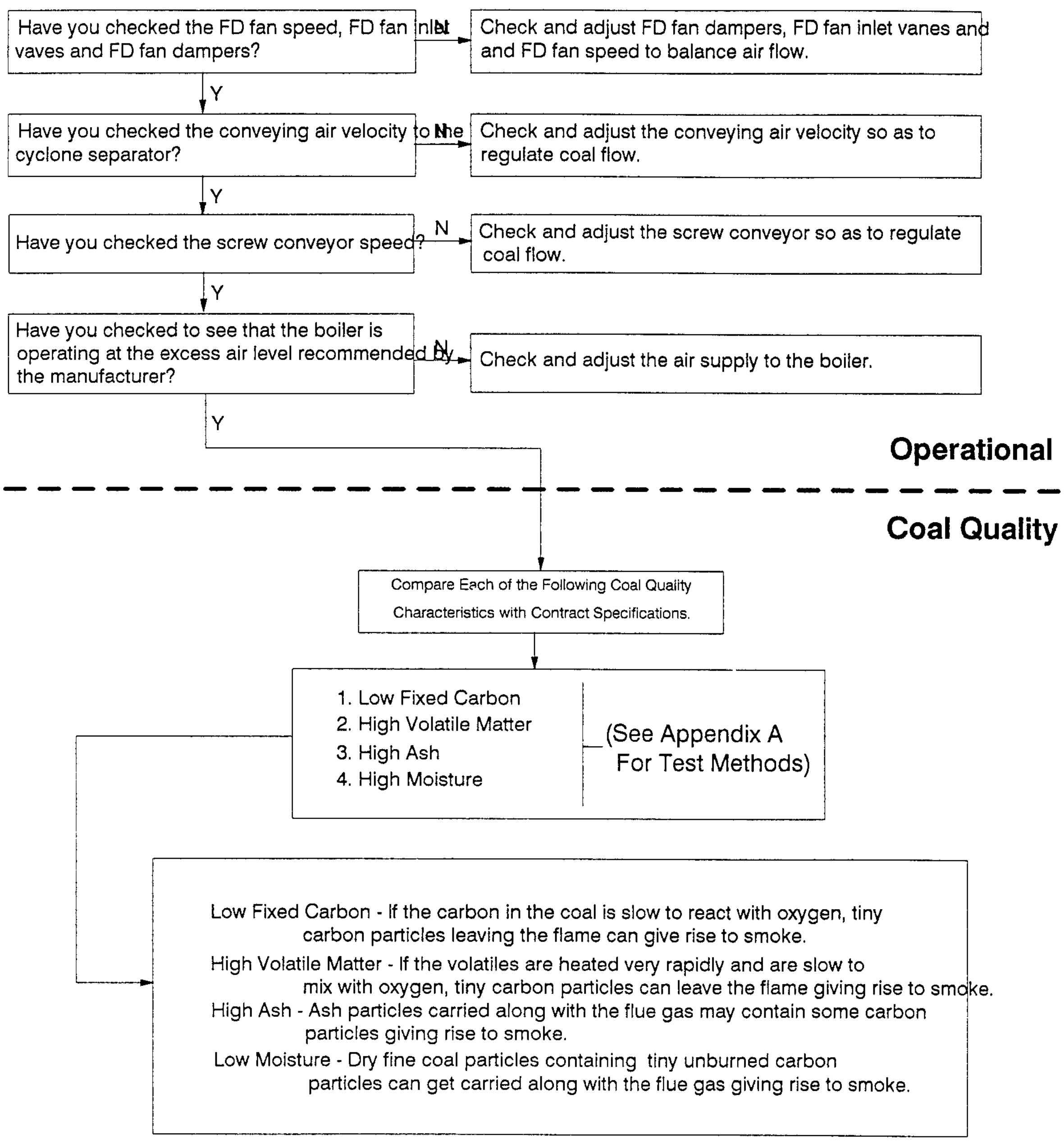


FIG4-40n/1

FIGURE 4-41: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load (Induced Draft Fan)

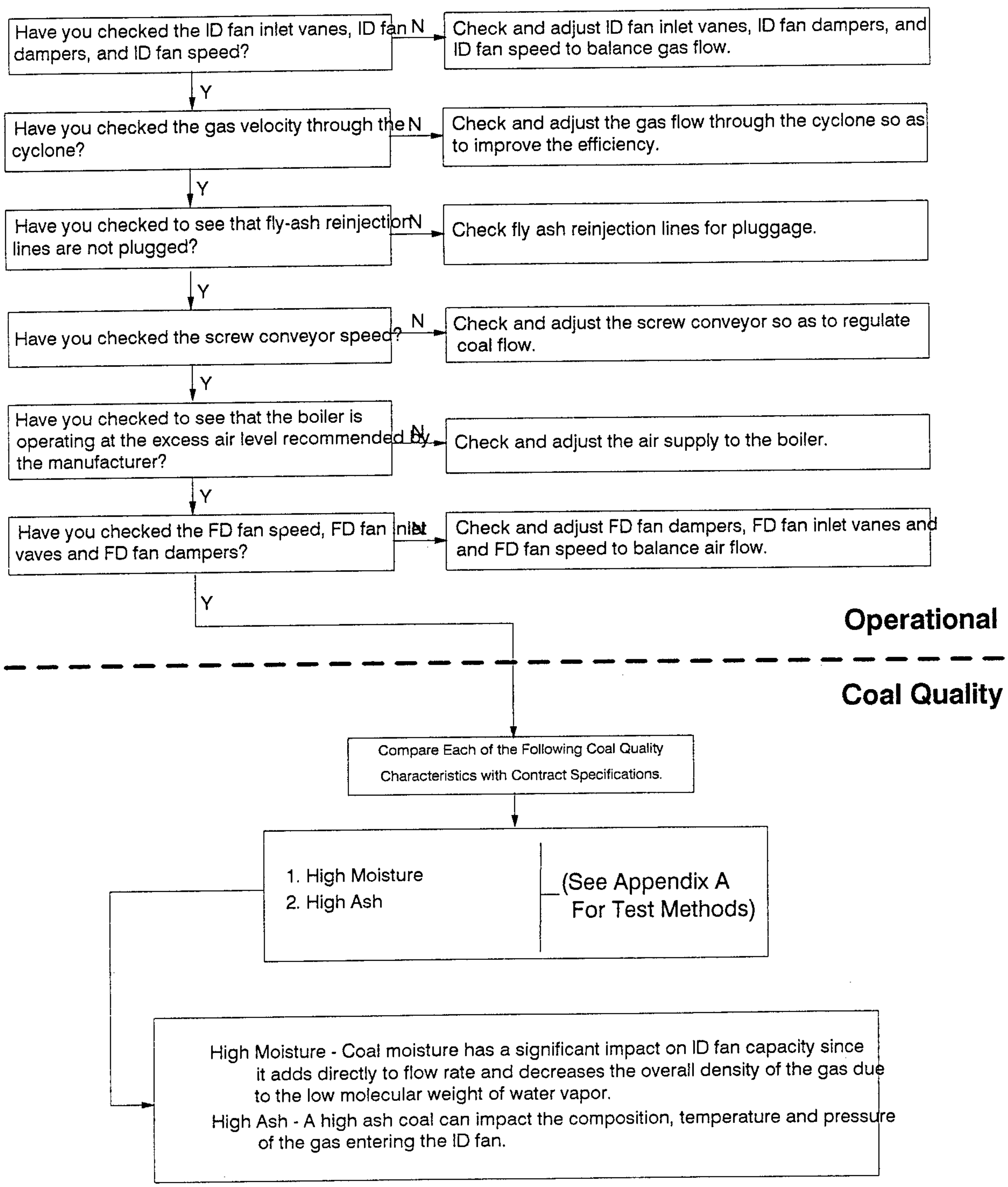


FIG4-41n/2

FIGURE 4-42: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Induced Draft Fan

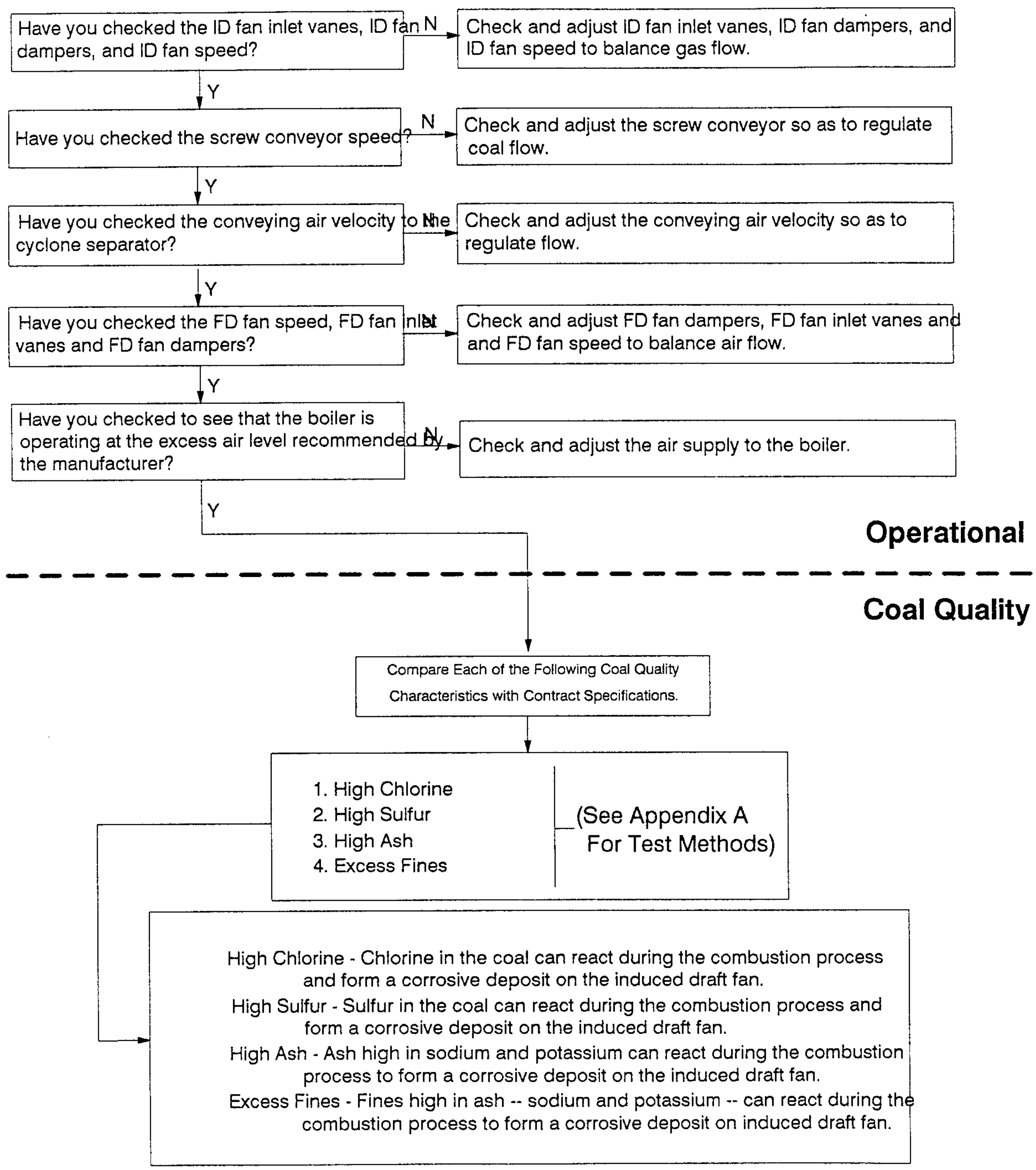
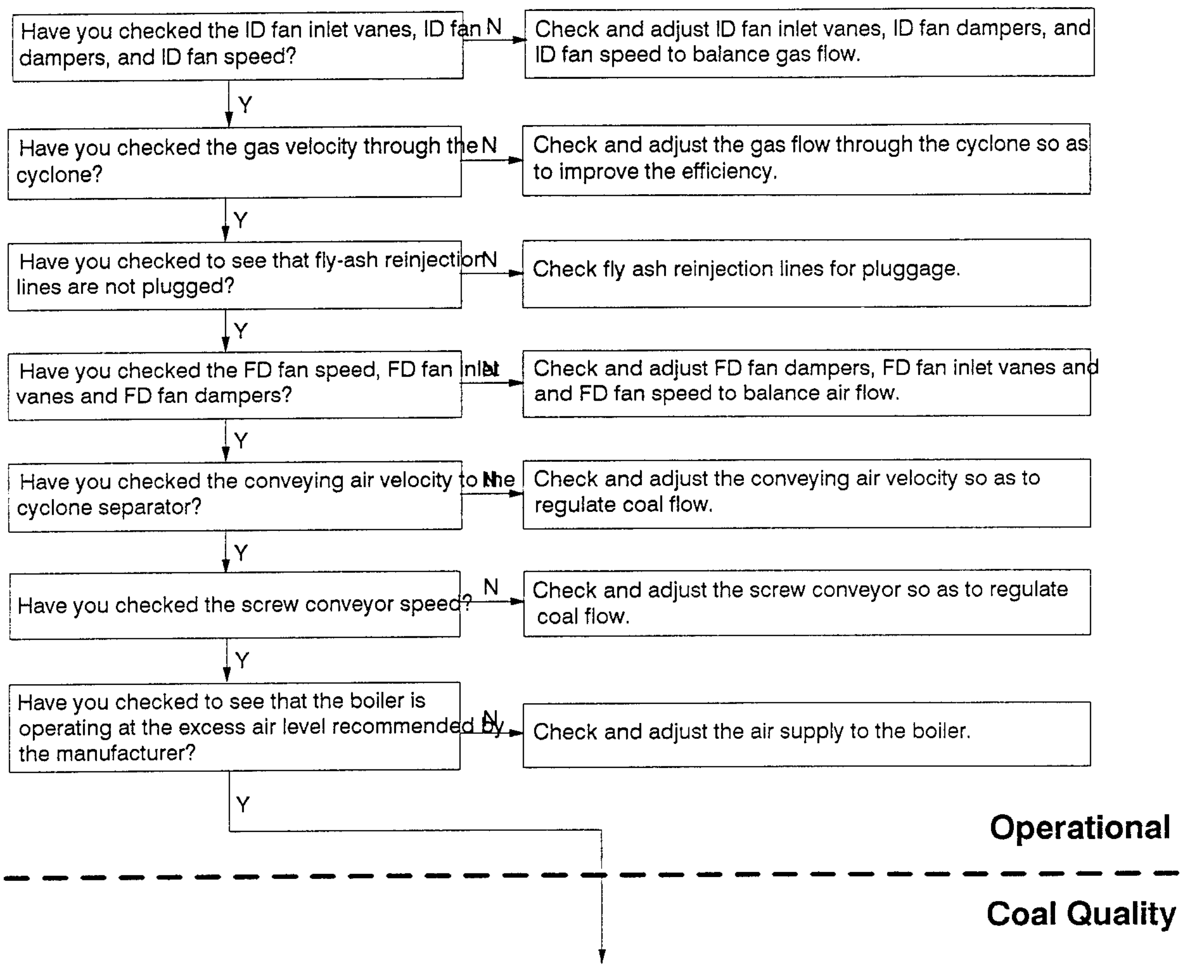


FIG4-42n/2

FIGURE 4-43: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Induced Draft Fan



See next page for Coal Quality Section.

FIG6-43n/2

FIGURE 4-43 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

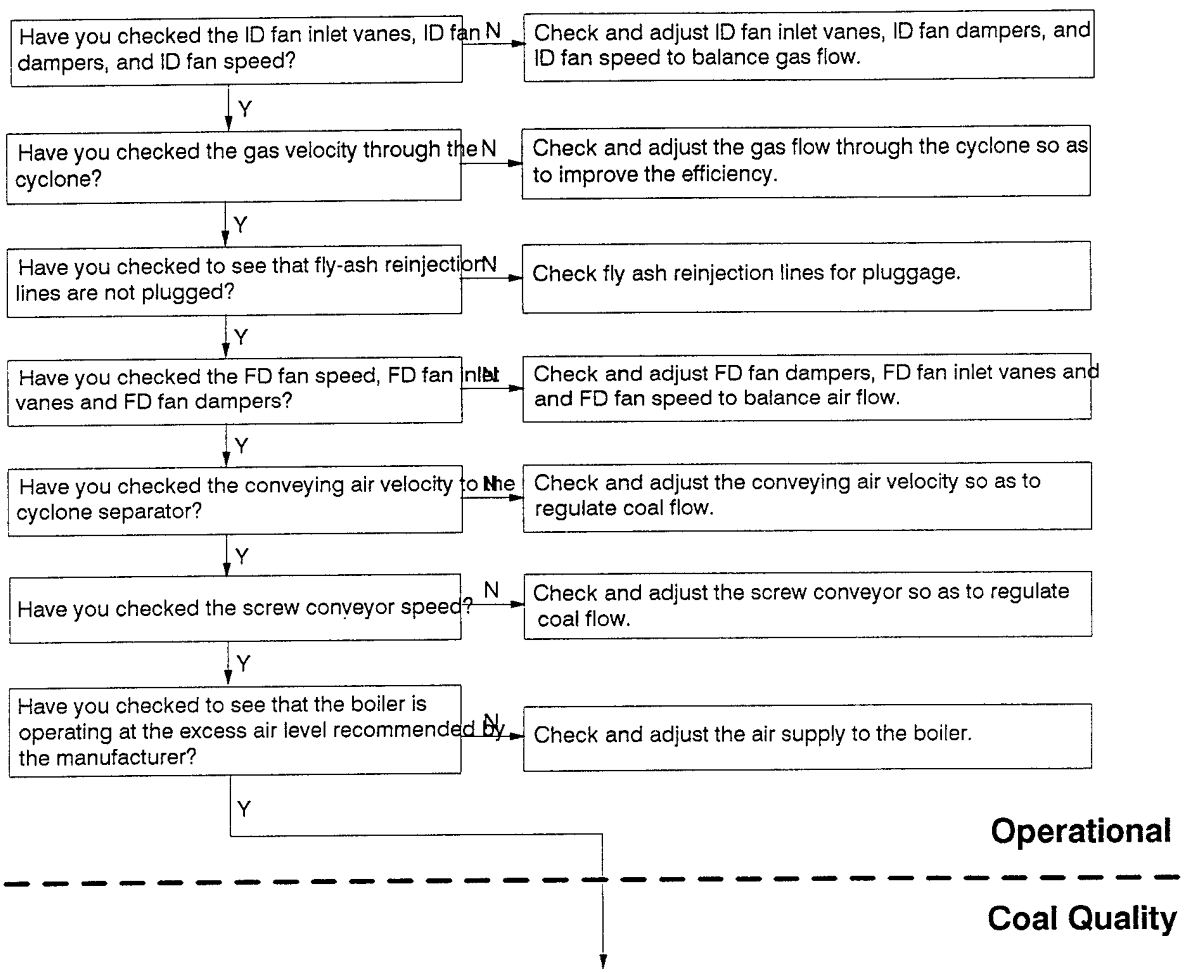
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG4-43nb/2

FIGURE 4-44: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Induced Draft Fan



See next page for Coal Quality Section.

FIG4-44n/2

FIGURE 4-44 (continued): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG4-44nb/2

FIGURE 4-45: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System (Cyclone)

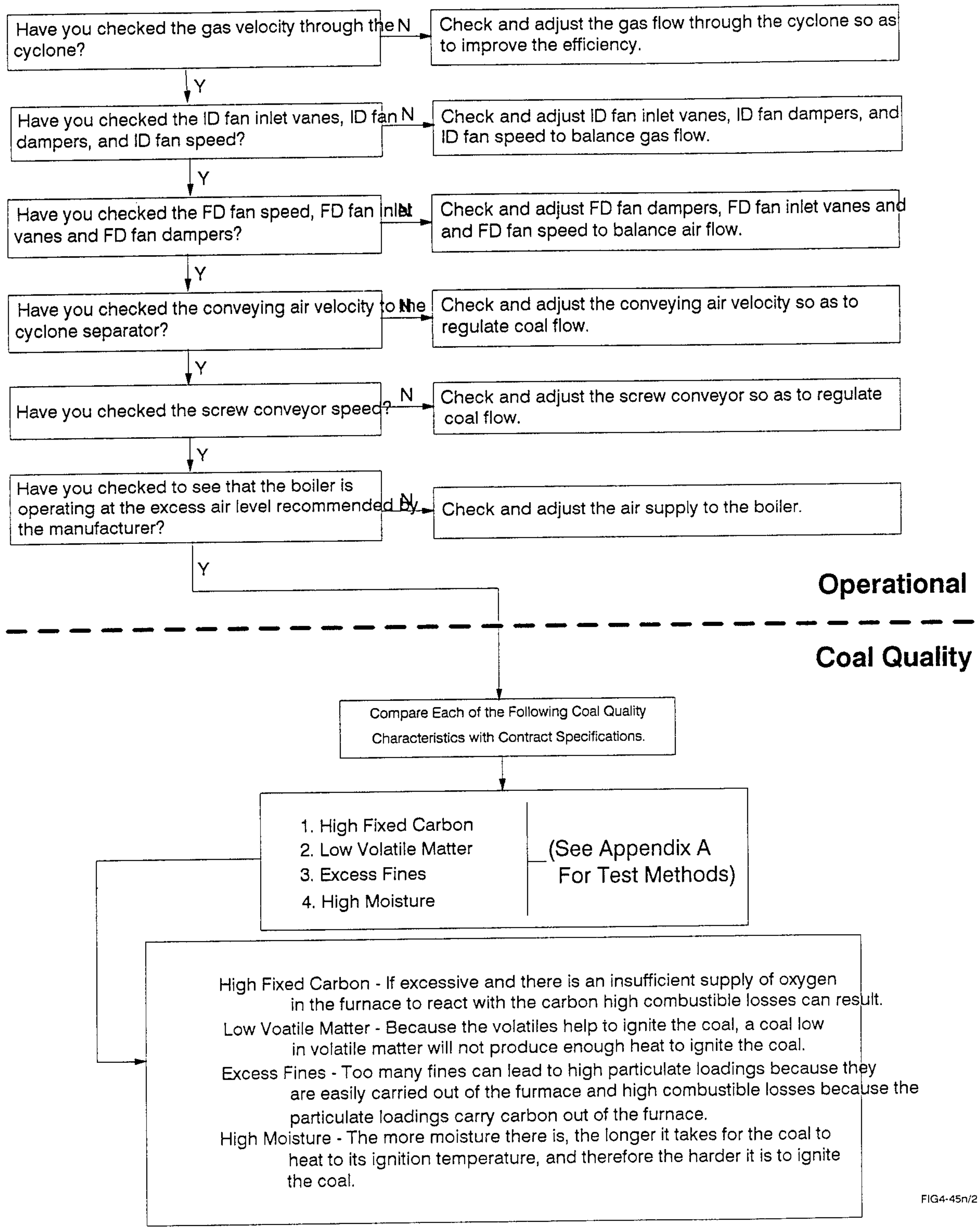
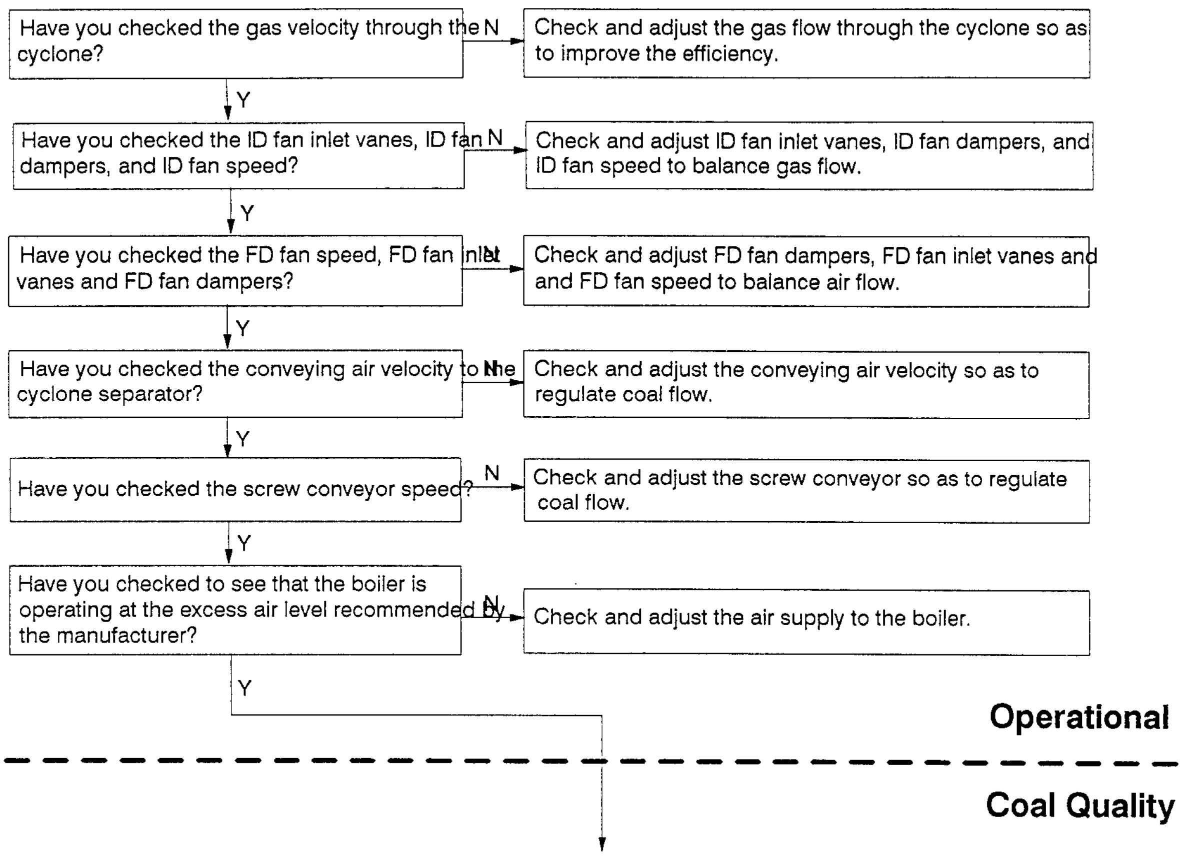


FIGURE 4-46: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System

(Cyclone)



See next page for Coal Quality Section.

FIG4-46n/2

FIGURE 4-46 (continued): TOP FEED STATIC GRATE STOKER
TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG4-46nb/2

FIGURE 4-47: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System

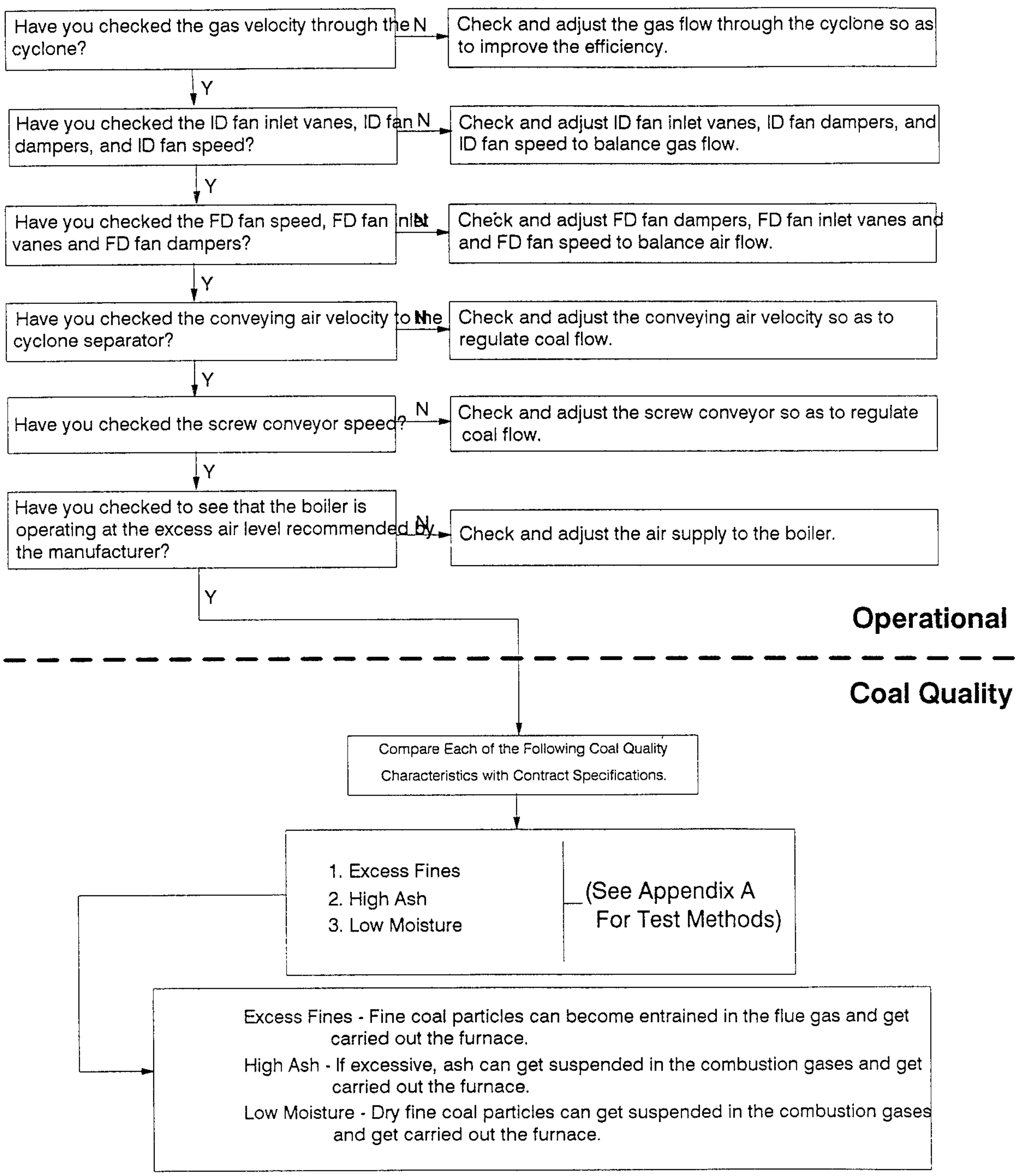


FIG4-47n/2

FIGURE 4-48: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Fly-Ash Recycle

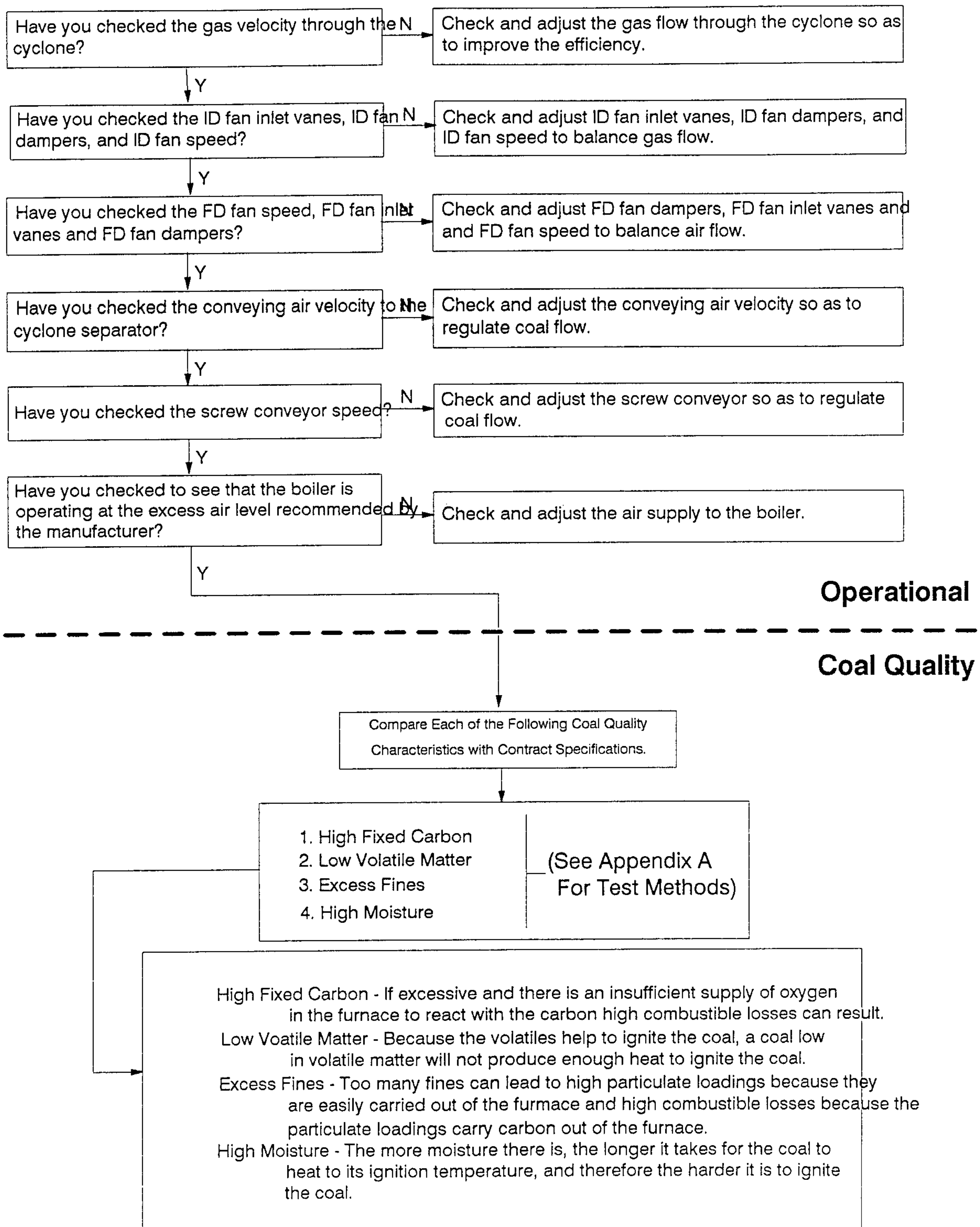


FIG4-48n/2

FIGURE 4-49: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Clinkers In The Ash Dollie

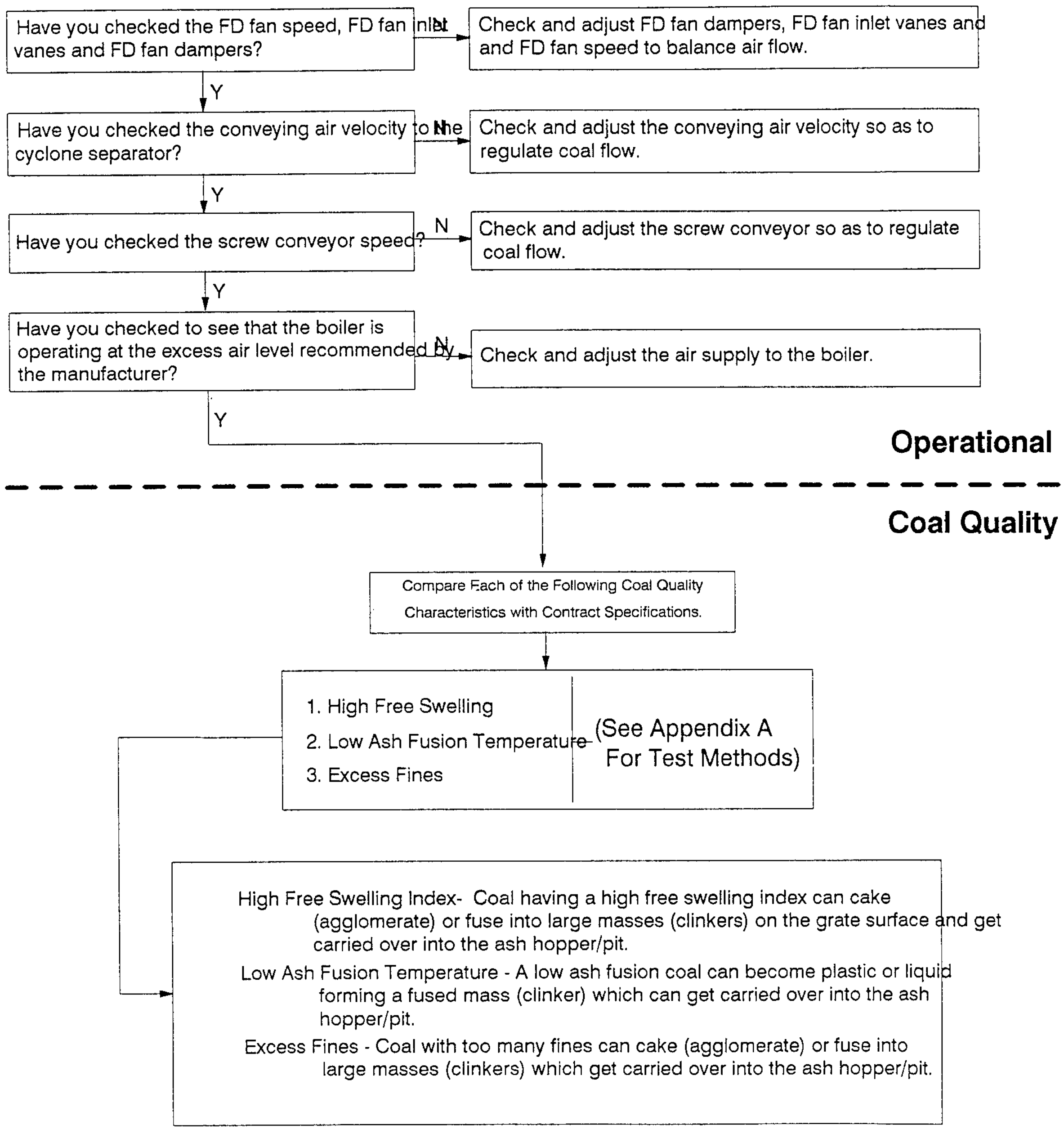


FIG4-49n/2

FIGURE 4-50: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Ash Dollie

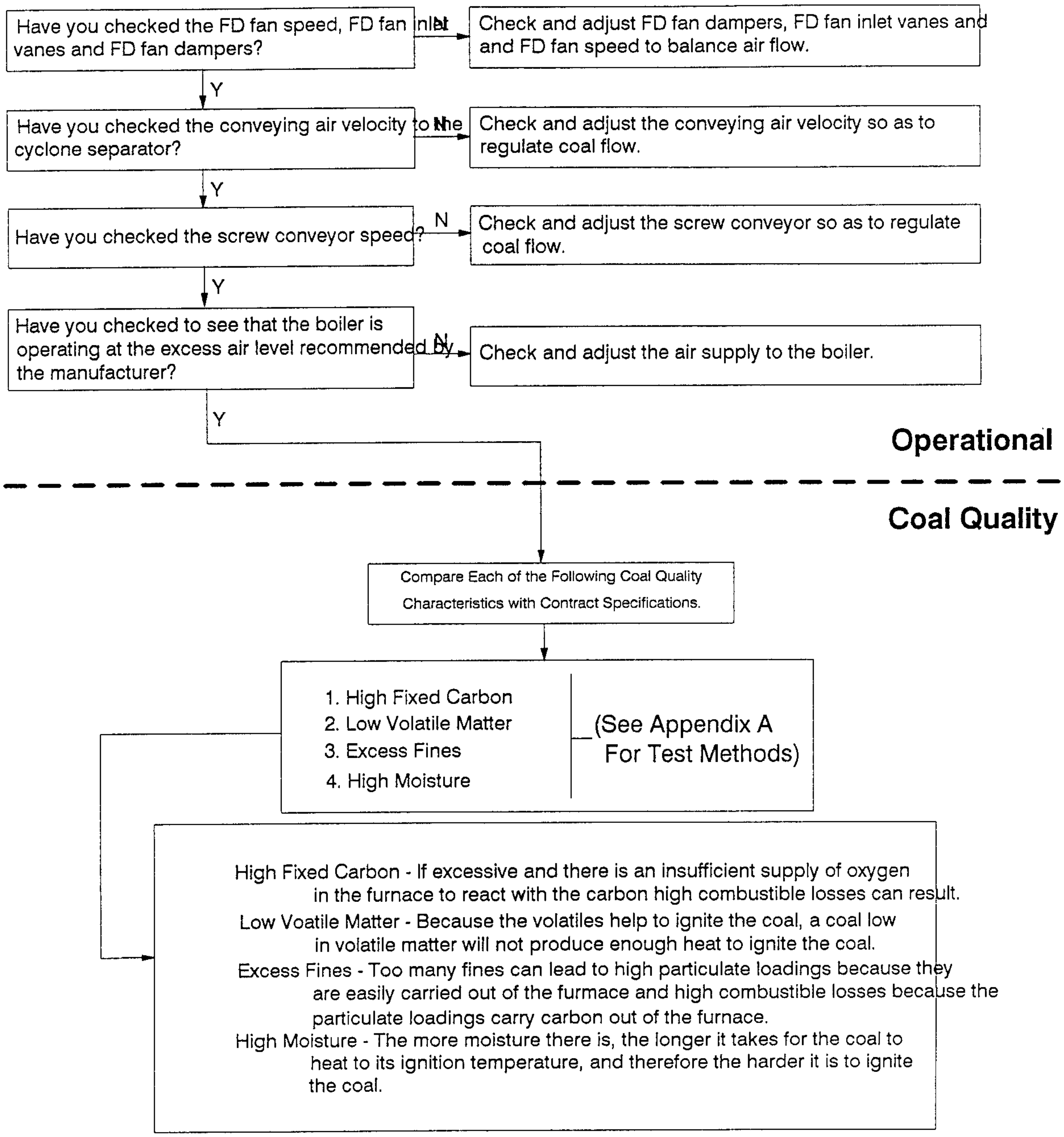


FIG4-50n/2

FIGURE 4-51: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of Stack/Chimney

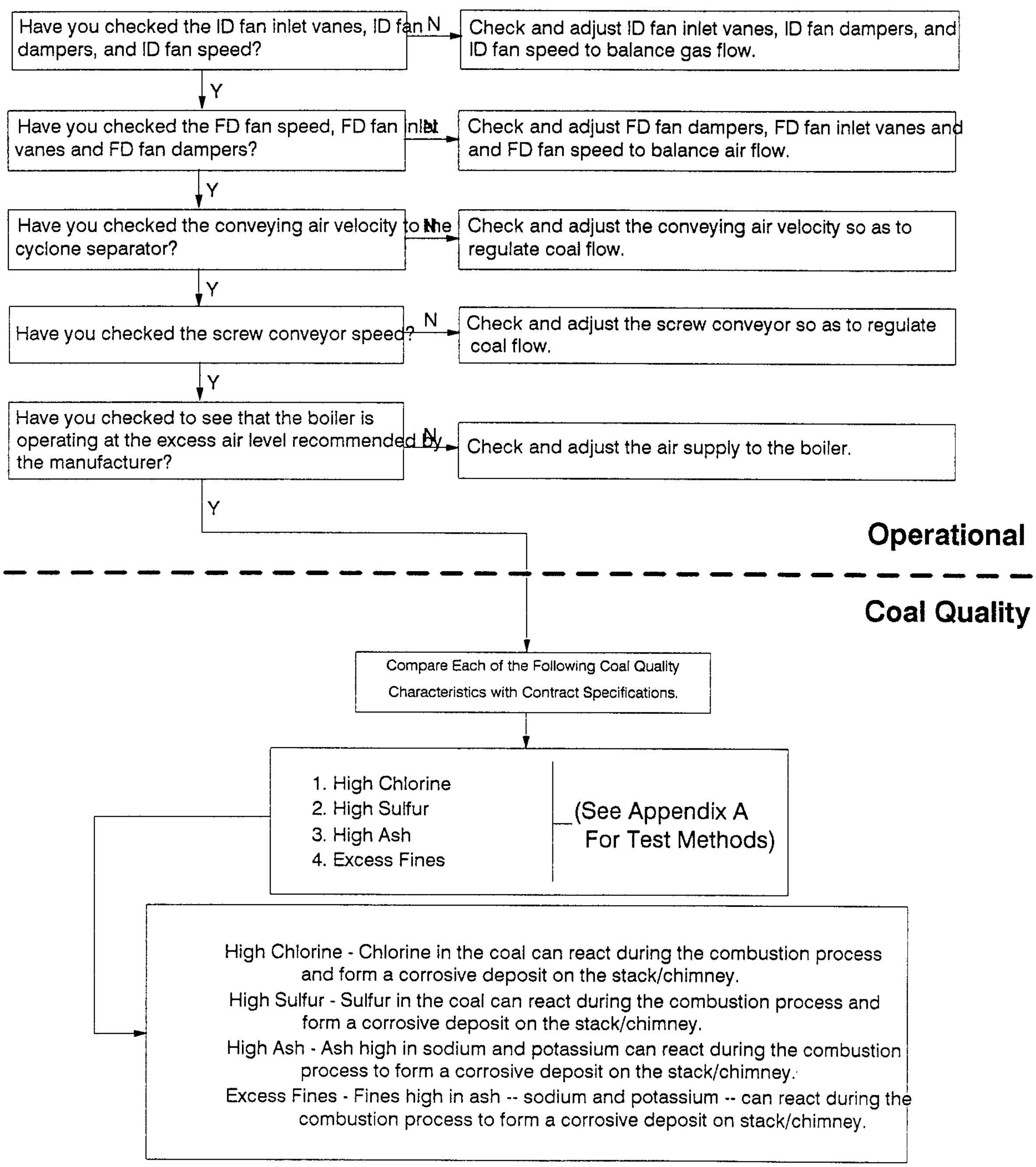


FIG4-51n/2

FIGURE 4-52: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Stack/Chimney

Have you checked to see that fly-ash reinjection lines are not plugged? —N→ Check fly ash reinjection lines for pluggage.

↓ Y

Have you checked the ID fan inlet vanes, ID fan dampers, and ID fan speed? —N→ Check and adjust ID fan inlet vanes, ID fan dampers, and ID fan speed to balance gas flow.

↓ Y

Have you checked the FD fan speed, FD fan inlet vanes and FD fan dampers? —N→ Check and adjust FD fan dampers, FD fan inlet vanes and FD fan speed to balance air flow.

↓ Y

Have you checked the conveying air velocity to the cyclone separator? —N→ Check and adjust the conveying air velocity so as to regulate coal flow.

↓ Y

Have you checked the screw conveyor speed? —N→ Check and adjust the screw conveyor so as to regulate coal flow.

↓ Y

Have you checked to see that the boiler is operating at the excess air level recommended by the manufacturer? —N→ Check and adjust the air supply to the boiler.

↓ Y

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

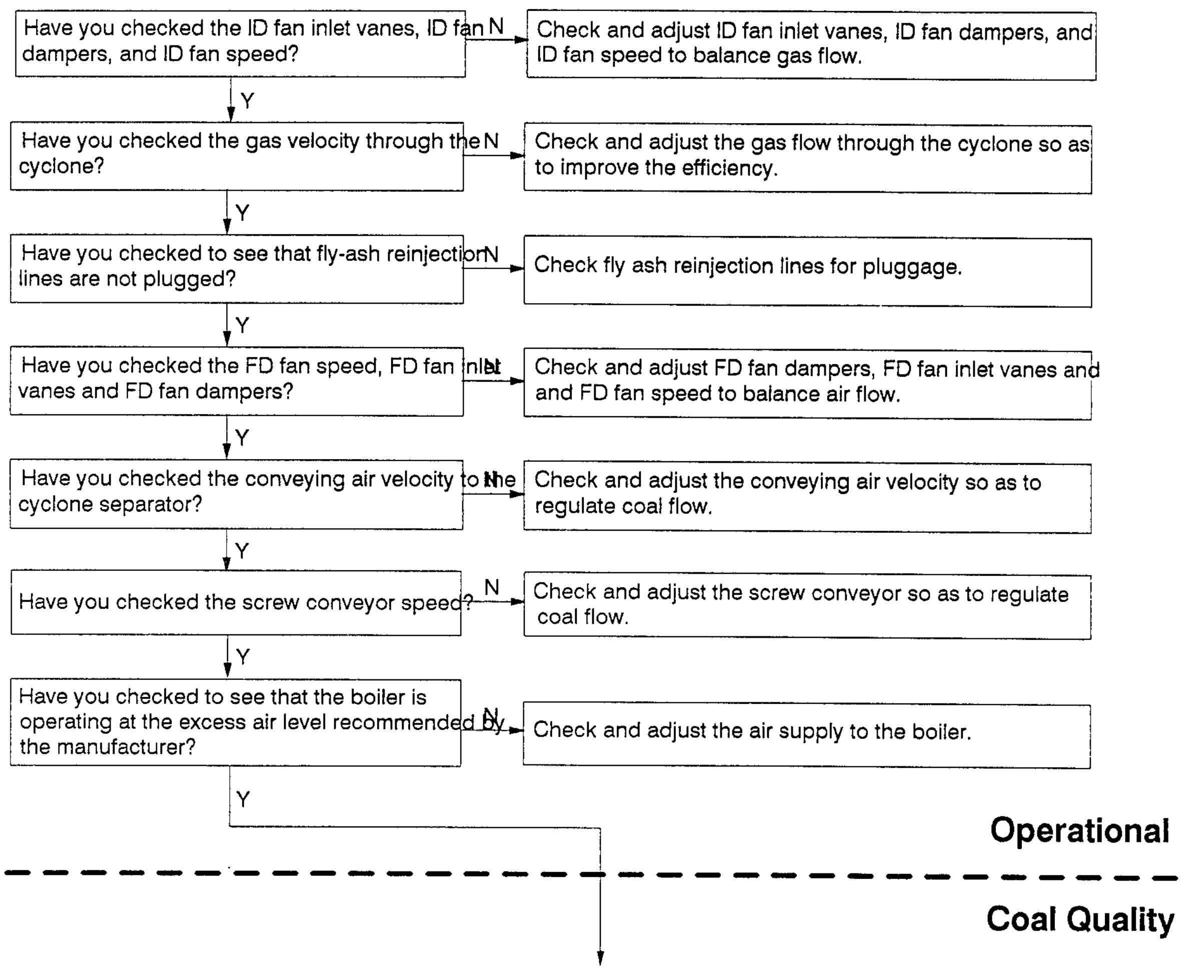
Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG4-52n/2

FIGURE 4-53: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Stack/Chimney



See next page for Coal Quality Section.

FIG4-53n/2

FIGURE 4-53 (continued): TOP FEED STATIC GRATE STOKER

TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

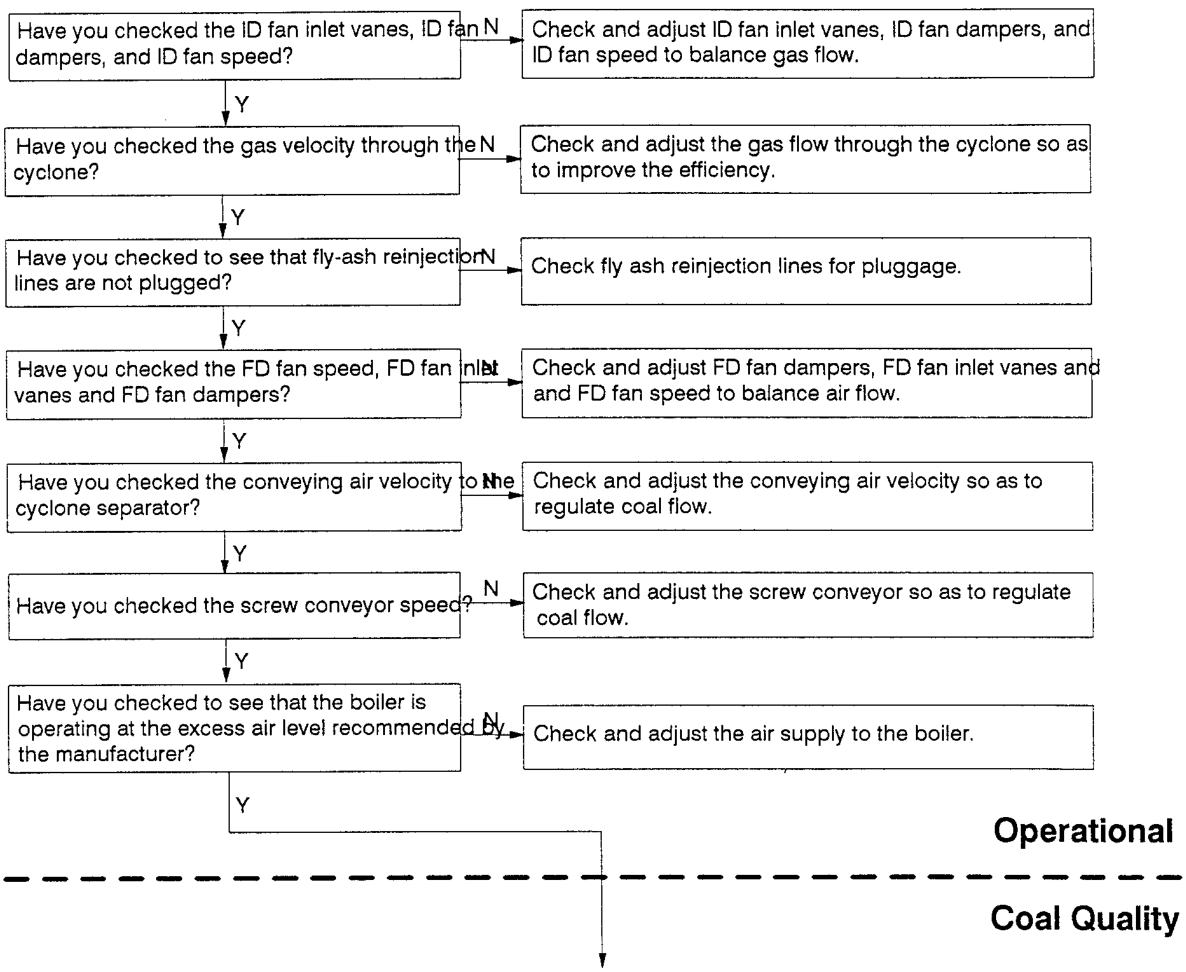
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG4-53nb/2

FIGURE 4-54: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIG4-54n/2

FIGURE 4-54 (CONT'D): TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For Diagnosing Excess Particulate Emissions From The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Fines
2. High Ash
3. Low Moisture

(See Appendix A For Test Methods)

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG4-54nb/3

FIGURE 4-55: TOP FEED STATIC GRATE STOKER TROUBLESHOOTING LOGIC DIAGRAM

For SO2 Emissions From The Stack/Chimney

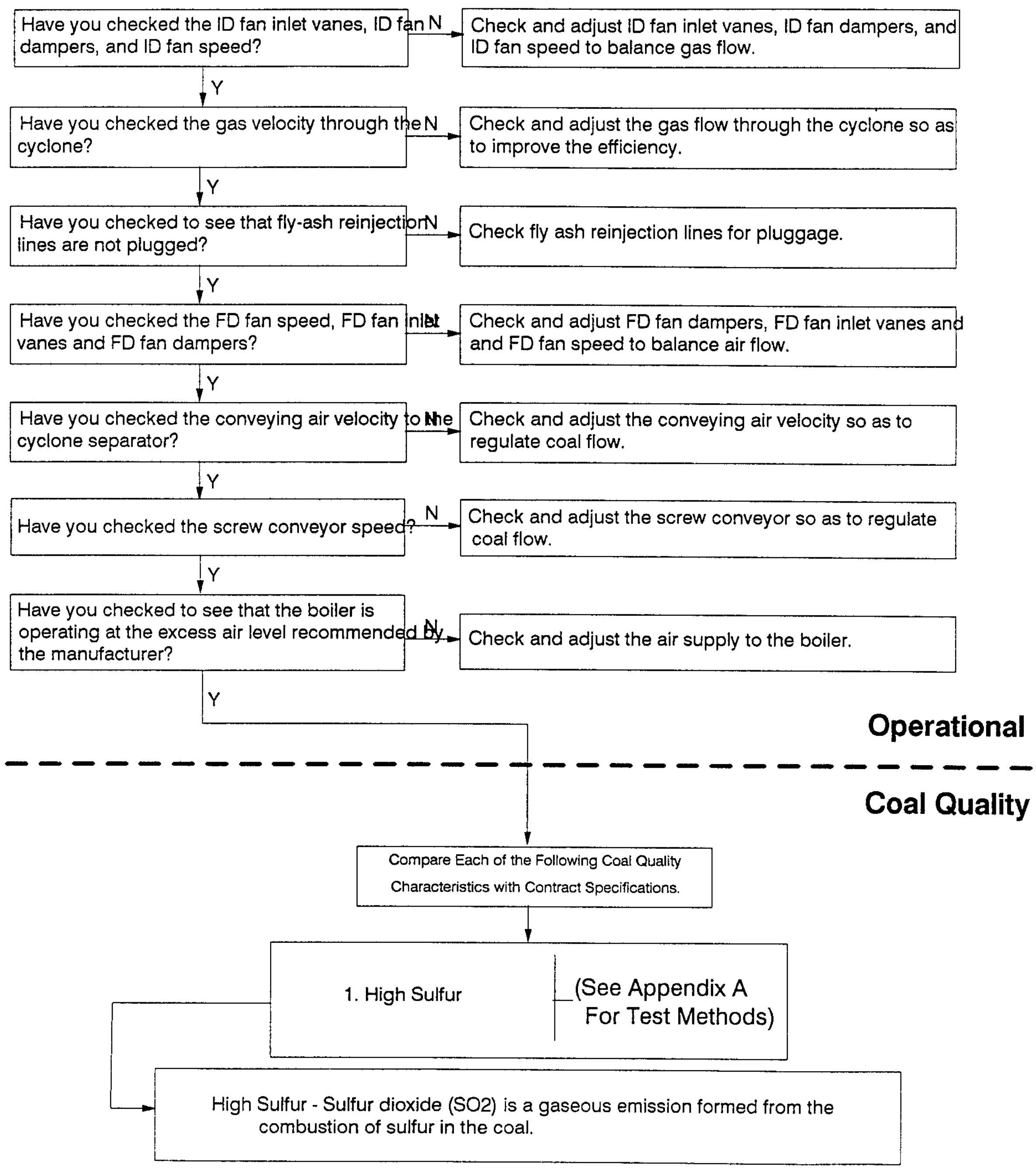


FIG4-55n/2

Appendix E: Pulverized Coal-Fired Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality related problems that can be encountered in pulverized coal-fired boiler systems. A general description of this system is included, but is limited to describing the major components that make up a complete pulverized coal-fired system. For those interested, more detailed descriptions are provided in reference 10.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

E1 System Description

Pulverized coal-fired (PC) boilers are commonly used in larger industrial facilities and utility power-generating units. PC boilers have an extensive and successful history in the power industry. Almost any coal can be burned successfully in pulverized form or in some type of stoker. However, with the development of pulverized-coal systems, capacity limitations imposed by stokers have been overcome. Pulverized coal firing systems offer the following advantages over stoker firing:

- ability to use fine coal and coarse coal—up to 2 in. in size
- improved response to load changes
- increase in thermal efficiency due to lower excess air for combustion and lower carbon loss
- ability to burn coal in combination with oil and gas.

Figure 5-1 shows a medium-speed pulverizer.

In PC firing, coal is pulverized so it is the consistency of talcum powder and is then introduced into the combustion chamber (furnace) where it is burned in suspension.

In the basic pulverized coal system (refer to Figure 5-3), the coal bunker (1) stores the coal before it flows onto the coal conveyor (2). The coal drops into the coal scale (3) and is weighed before being dumped into the coal chute (4) that leads to the coal feeder (5).

The coal feeder controls the flow of coal entering the pulverizer (6), which is motor driven. The pulverizer grinds the coal to a fine powder. Hot air (8) enters the pulverizer and mixes the coal powder before passing to the exhauster. More commonly a blower would be located on the inlet side of the pulverizer to pickup the pulverized coal and deliver it to the burners. The mixture of coal and air is then discharged to the burner (10).

E1.1 Pulverized-Coal Systems

The function of a pulverized-coal system is to:

- pulverize the coal
- deliver the coal to the fuel-burning equipment
- accomplish complete combustion in the furnace with minimum excess air.

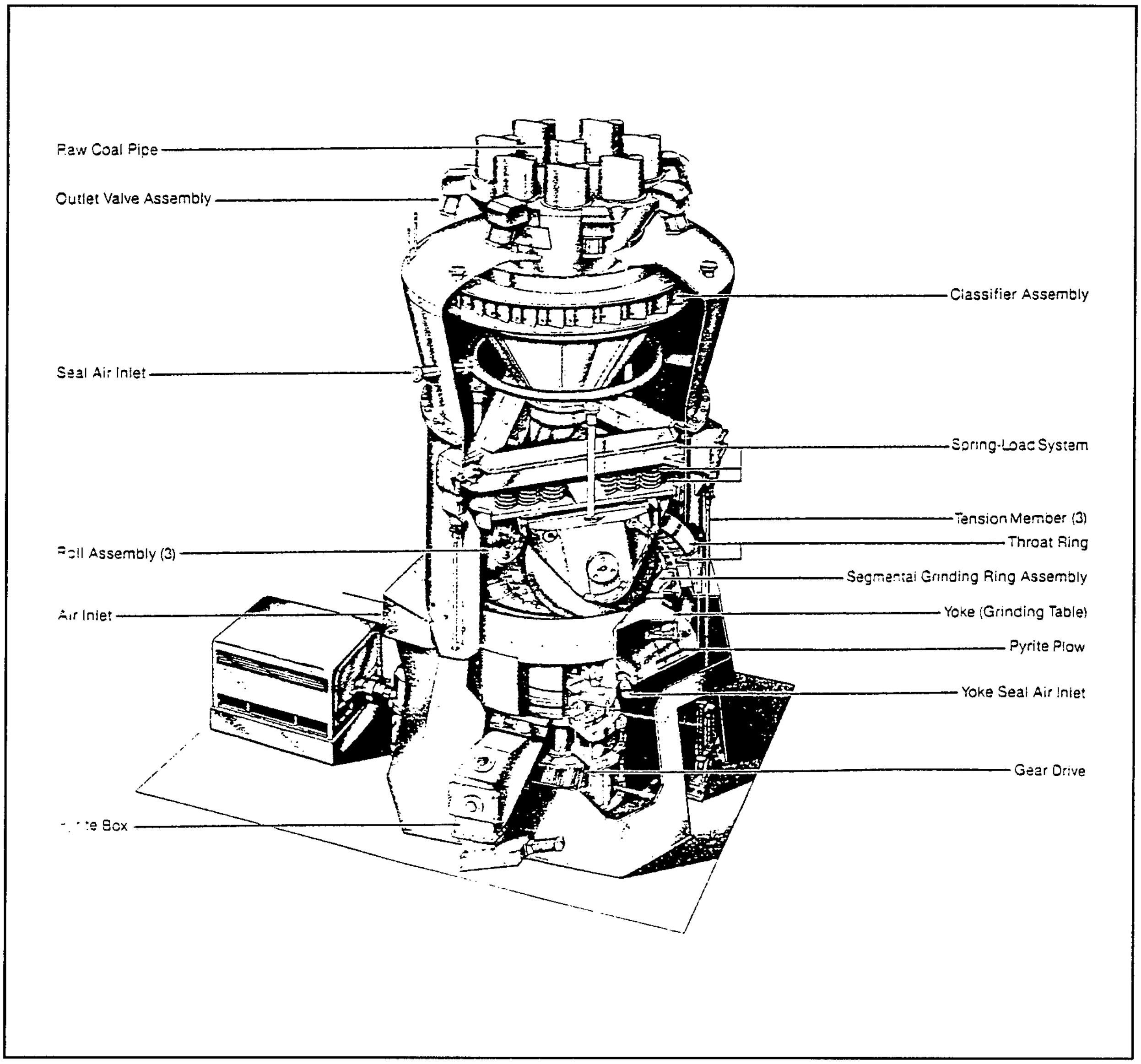


Figure 5-1. Medium speed pulverizer mill.

The system must operate as a continuous process and, within specified design limitations, the coal supply or feed can be varied as rapidly and as widely as required by the combustion process.

A small portion of air—known as primary air—required for combustion (15 to 20 percent in current installations) is used to transport the coal to the burner and to dry the coal in the pulverizer. The remainder of the combustion air (80 to 85 percent)—known as secondary air—is introduced at the burner to adjust for proper fuel-to-air ratio.

Some basic equipment components of a pulverized coal system are:

- the pulverizer, which pulverizes the coal to the fineness required (usually 70 percent passing 200 mesh)
- the burners, which mix the pulverized coal primary-air mixture with secondary air in the right proportions
- fan(s) to supply the pulverizer with air and deliver the coal-air mixture to the burners
- coal feeder(s) to control the coal feed rate to each pulverizer
- coal and air conveying lines.

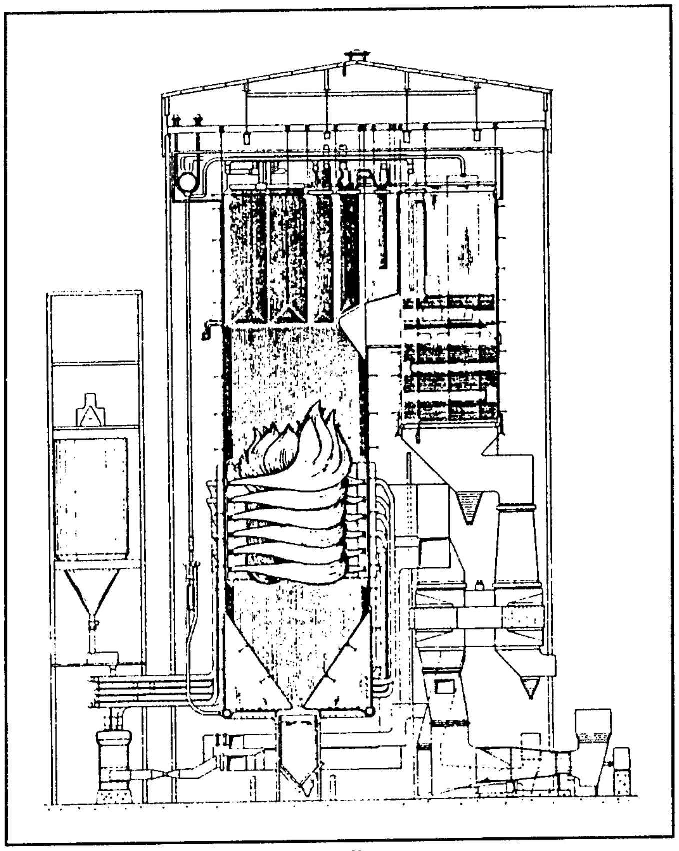


Figure 5-2. Pulverized coal boiler.

Two principal systems—the bin system and the direct firing system—have been used for processing (pulverizing), distributing, and burning pulverized coal. The direct-firing system is the one being installed almost exclusively today.

E1.2 Direct-Firing System

The pulverizing equipment developed for the direct-firing system permits continuous use of raw coal directly from bunker(s) with a storage capacity compatible with plant operation. Coal at a maximum 2-in. top size is fed directly into the pulverizer(s) where it is dried, pulverized, and delivered to the burners in a single continuous operation.

Components of the direct-firing system are:

- raw-coal feeder
- source (steam or gas air heater) to supply hot primary air to the pulverizer for drying the coal
- pulverizer fan, also known as the primary-air fan
- pulverizer
- coal-and-air conveying lines
- burners.

E2 Block Flow Diagram

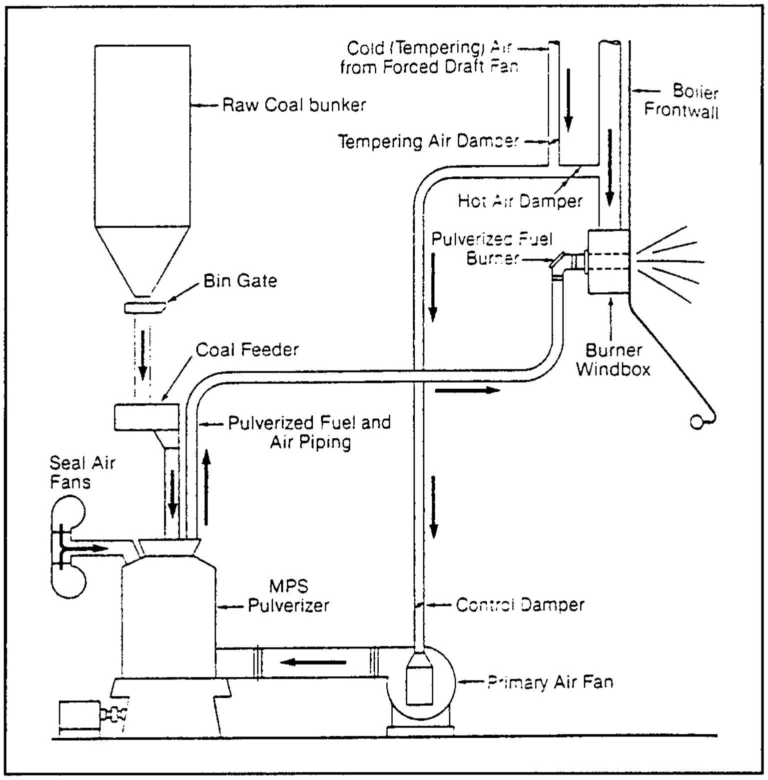


Figure 5-3. Pulverized coal system.

The pulverized coal-fired boiler system has been divided into 13 specific subsystems or components—whose performance can be significantly impacted by coal quality—sequentially arranged to show:

- coal flow through the coal handling equipment
- flue gas flow through the boiler/components, flyash recycle, the induced draft fan, and chimney/stack
- ash discharge to the ash hopper/pit.

These specific components are identified in Figure 5-4. The first four components have been grouped collectively under a category entitled coal handling equipment. The coal handling equipment includes all components that process the coal from its delivery on site to the boiler. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders, and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- coal feeders that transport raw and pulverized coal.

The next four components have been loosely grouped under the category entitled Boiler/Components. Again, it includes equipment that depending on plant design may include:

- forced draft fan
- heat transfer surfaces—boiler tubes, water walls and baffles.

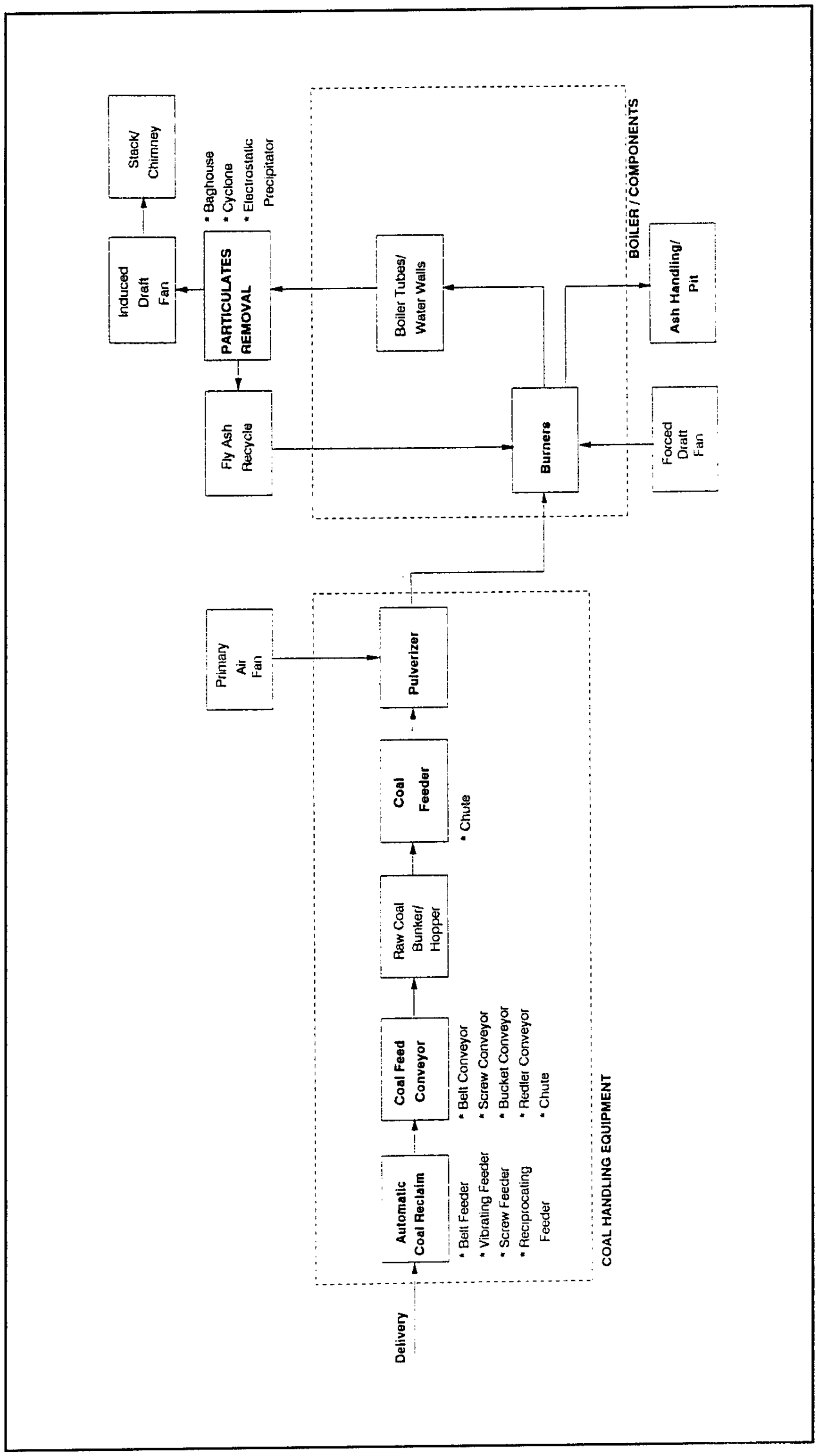


Figure 5-4. Pulverizer coal-fired boiler system components block flow diagram.

The next two blocks represent the flyash recycle and particulate removal subsystem. Three particulate removal options separately or in combination will be considered: cyclones, electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. Pulverized coal-fired boiler systems use a number of fans to move air and flue gas. The major fan types addressed in the guide include:

- primary air (PA) fans, which supply air to the pulverizers
- forced draft (FD) fans, which supply air to the windbox (burner)
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/ pit.

E3 Troubleshooting Logic

The component/symptom guide table (Figure 5-5) serves to identify:

- Typical symptoms (problems) that may be encountered in pulverized coal-fired boiler systems. These symptoms are arranged horizontally along the top of the table.
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram.
- The location of the logic diagrams.

The remainder of this Appendix consists of 78 logic diagrams, arranged by component and all the symptoms that can affect that component.

(Part 1): PULVERIZED COAL - COMPONENT/SYMPTO

SYMPTOM

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	INSUFFICIENT PULVERIZING	UNEVEN BURNING	EXCESSIVE PULVERIZING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS	INSUFFICIENT DRYING
COAL HANDLING EQUIPMEN																			
Automatic Coal Reclaim																			
1) Belt Feeder	• 5-6	• 5-7	• 5-8	• 5-9															
2) Vibrating Feeder	• 5-10	• 5-11	• 5-12	• 5-13															
3) Screw Feeder	• 5-14	• 5-15	• 5-16	• 5-17															
4) Reciprocating Feeder	• 5-18	• 5-19	• 5-20	• 5-21															
Coal Feed Conveyor																			
1) Belt Conveyor	• 5-22	• 5-23	• 5-24	• 5-25															
2) Screw Conveyor	• 5-26	• 5-27	• 5-28	• 5-29															
3) Bucket Conveyor	• 5-30	• 5-31	• 5-32	• 5-33															
4) Redler Conveyor	• 5-34	• 5-35	• 5-36	• 5-37															
5) Chute		• 5-38	• 5-39	• 5-40															

Figure 5-5. Pulverized coal—component system guide (part 1).

(Part 2): PULVERIZED COAL - COMPONENT/SYMPTOM

SYMPTOM

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	INSUFFICIENT PULVERIZING	UNEVEN BURNING	EXCESSIVE PULVERIZING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE EMISSIONS	SO2 EMISSIONS	INSUFFICIENT DRYING
COAL HANDLING EQUIP.(CONT'D																			
Coal Feeders																			
Chute		• 5-41	• 5-42	• 5-43															
Coal Bunker		• 5-44	• 5-45	• 5-46															
Coal Hopper		• 5-47	• 5-48	• 5-49															
Pulverizer							• 5-50		• 5-51										• 5-52
BOILER / COMPONENTS																			
Boiler			• 5-53									• 5-54							
1) Burners		• 5-55												• 5-56					
2) Boiler Tubes/Water Walls					• 5-57									• 5-58	• 5-59	• 5-60			

Figure 5-5. Pulverized coal—component system guide (part 2).

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	INSUFFICIENT PULVERIZING	UNEVEN BURNING	EXCESSIVE PULVERIZING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE	SO2 EMISSIONS	INSUFFICIENT DRYING
		SYMPTOM																	
FANS																			
1) Forced Draft			● 5-61										● 5-62						
2) Induced Draft			● 5-63		● 5-64								● 5-65	● 5-66					
3) Primary Air			● 5-67										● 5-68						
PARTICULATE REMOVAL																			
1) Baghouse											● 5-69						● 5-70		
2) Cyclone											● 5-71			● 5-72			● 5-73		
3) Electrostatic Precipitator											● 5-74			● 5-75			● 5-76		
ASH HANDLING																			
1) Fly Ash Recycle											● 5-77								
2) Ash Hopper/Pit											● 5-78								
Stack/Chimney					● 5-79						● 5-80		● 5-81				● 5-82	● 5-83	

Figure 5-5. Pulverized coal—component system guide (part 3).

FIGURE 5-6: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Belt Feeder)

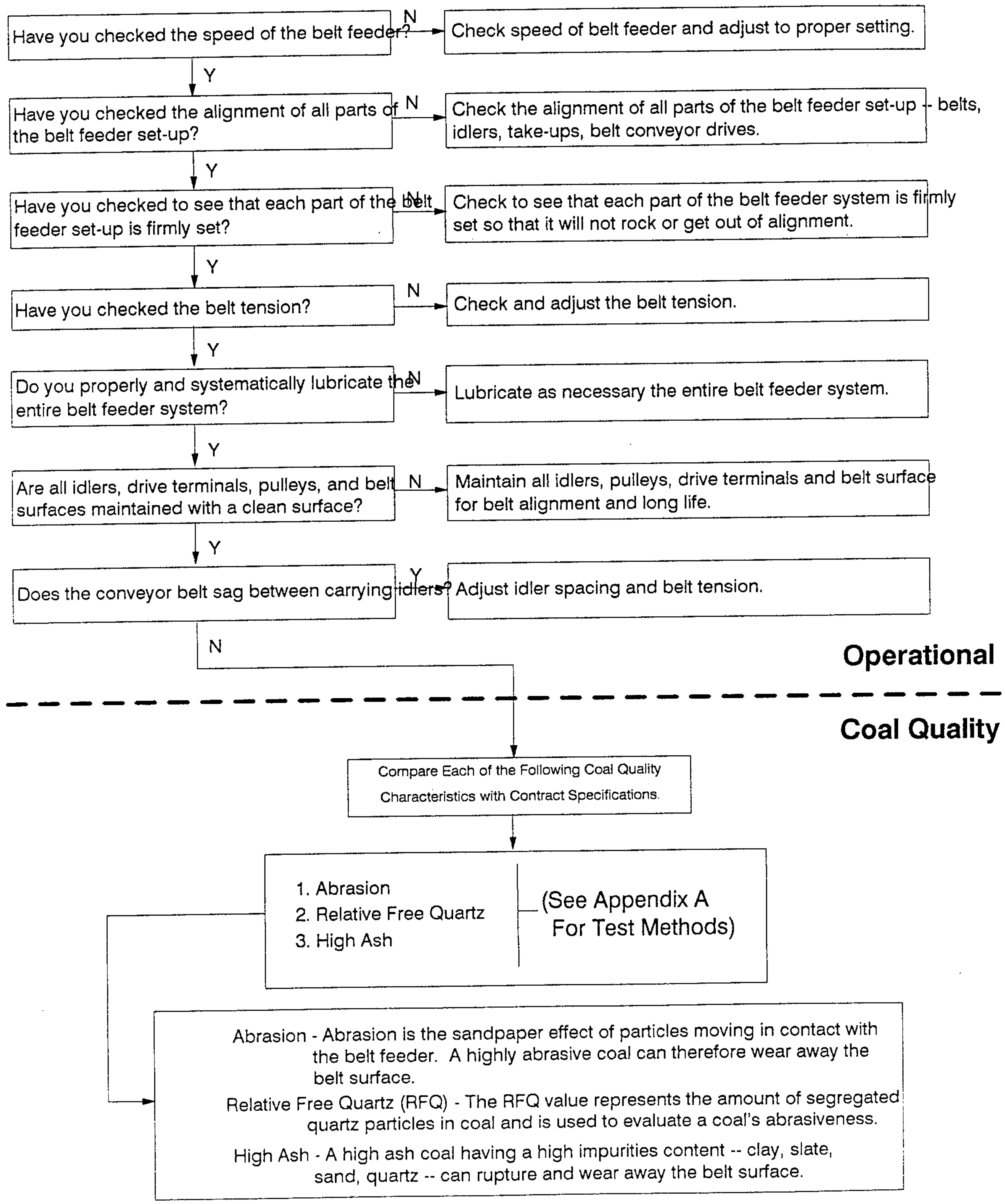


FIG5-6n/1

FIGURE 5-7: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Belt Feeder)

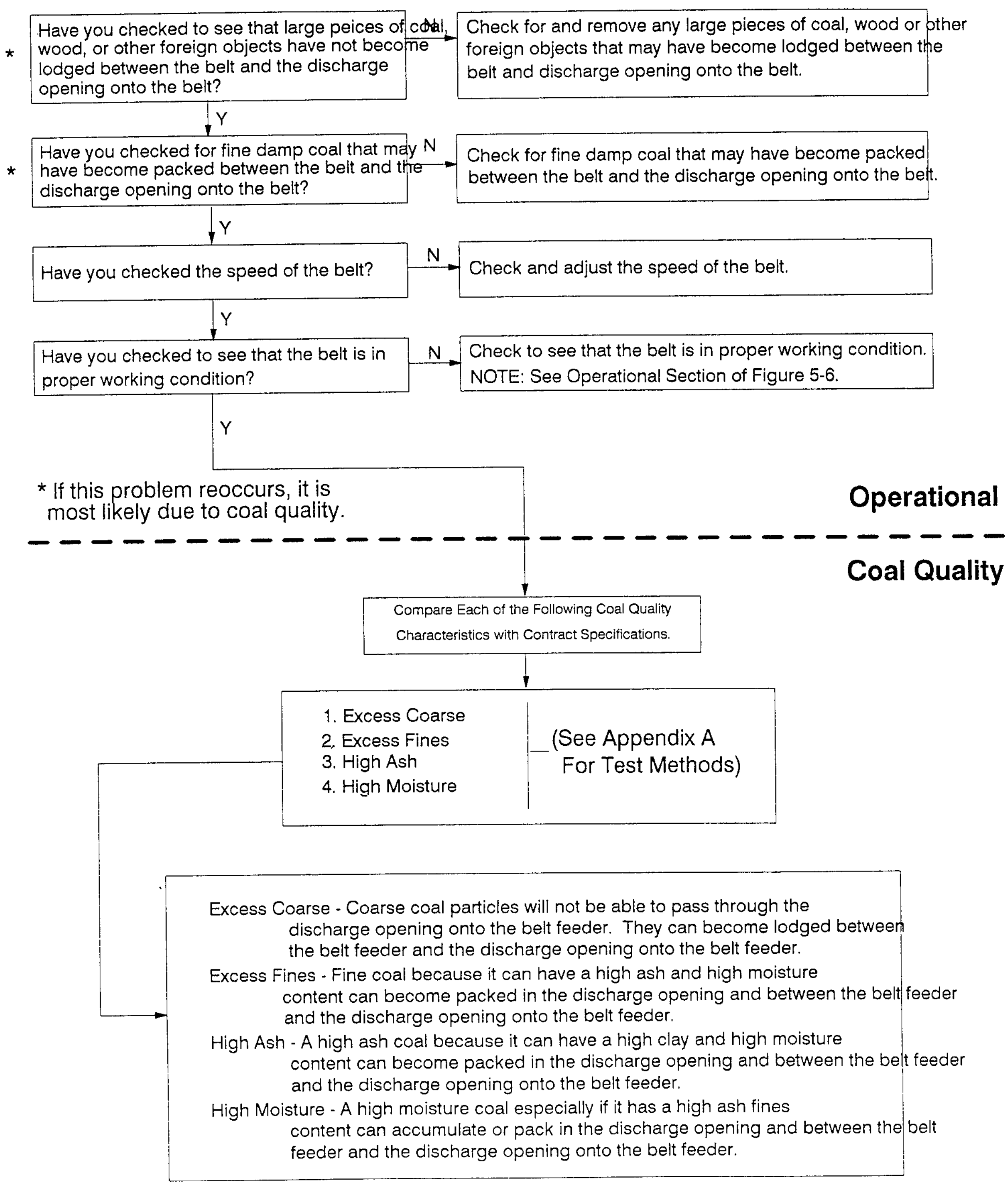


FIG5-7n/1

FIGURE 5-8: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Belt Feeder)

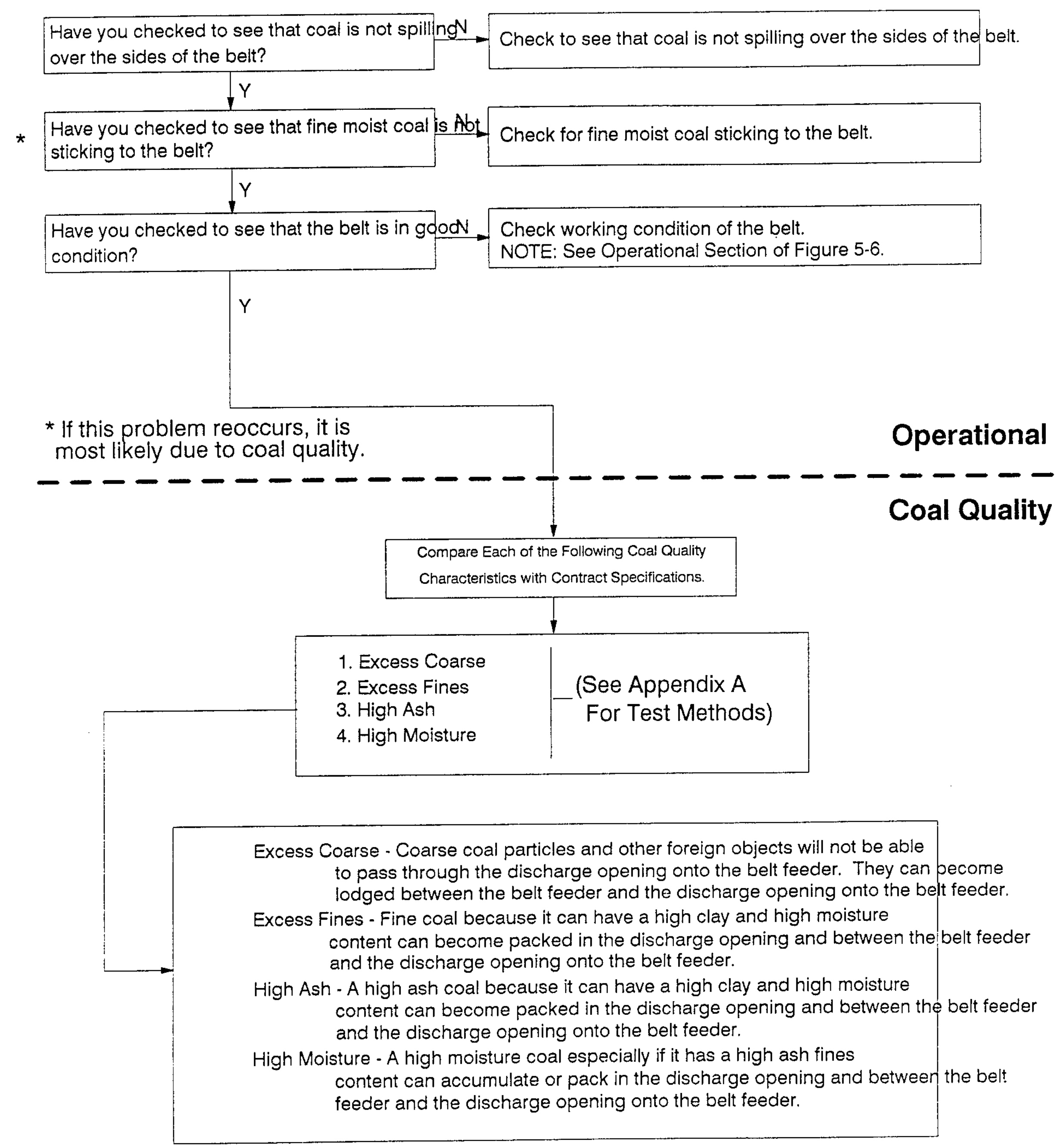


FIG5-8n/1

FIGURE 5-9: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim
(Belt Feeder)

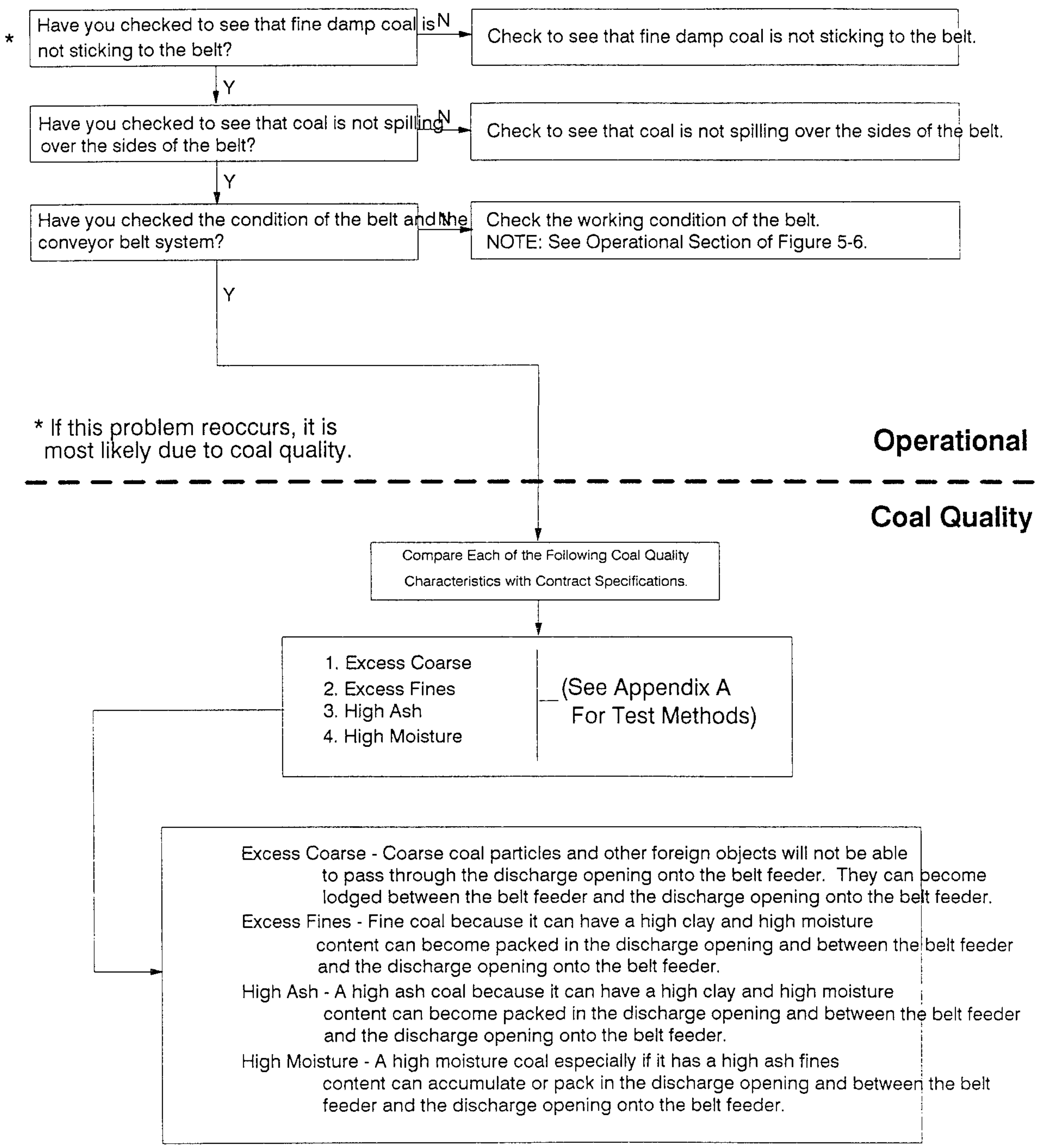


FIG5-9n/1

FIGURE 5-10: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Vibrating Feeder)

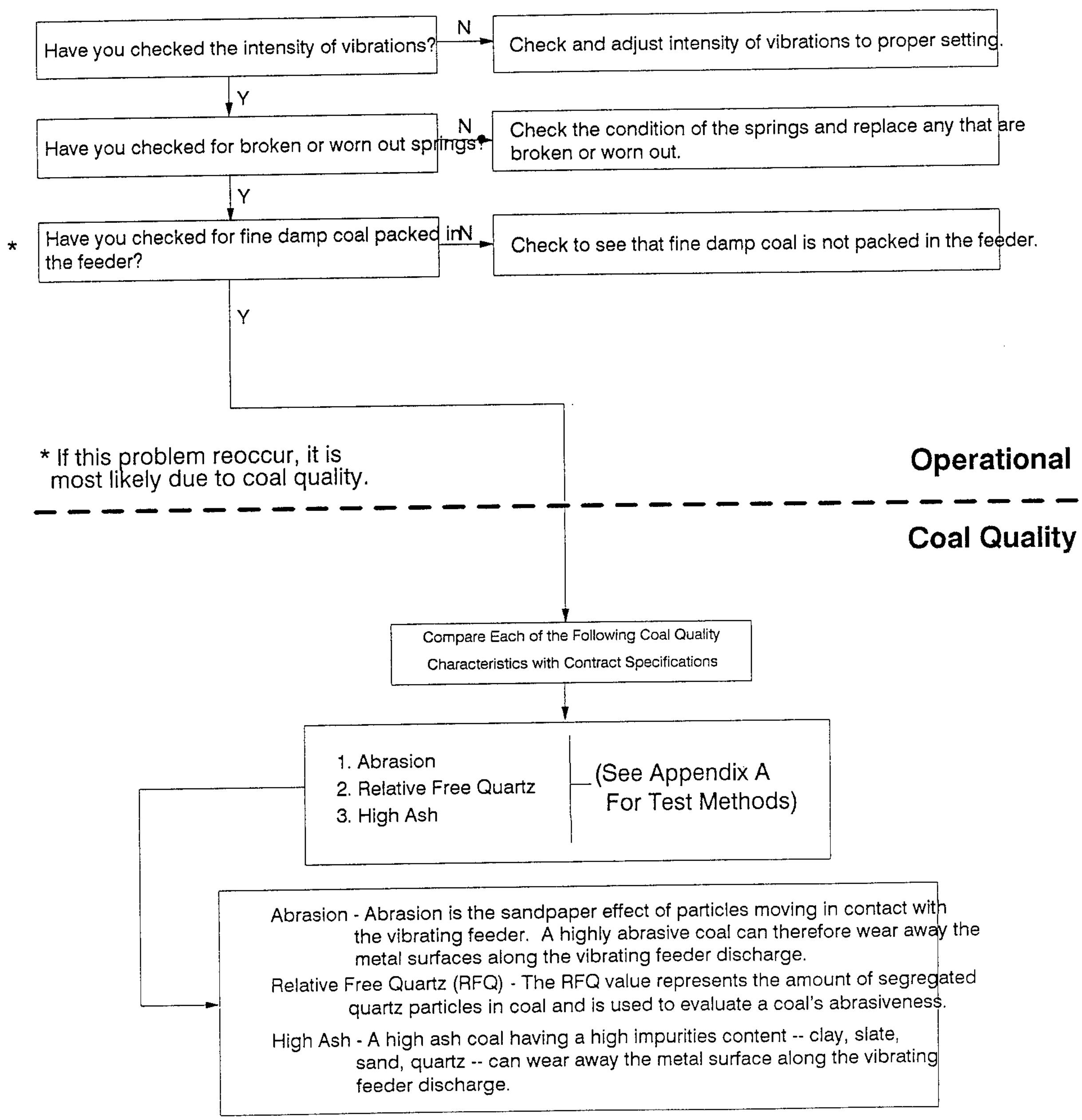


FIG5-10n/1

FIGURE 5-11: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Vibrating Feeder)

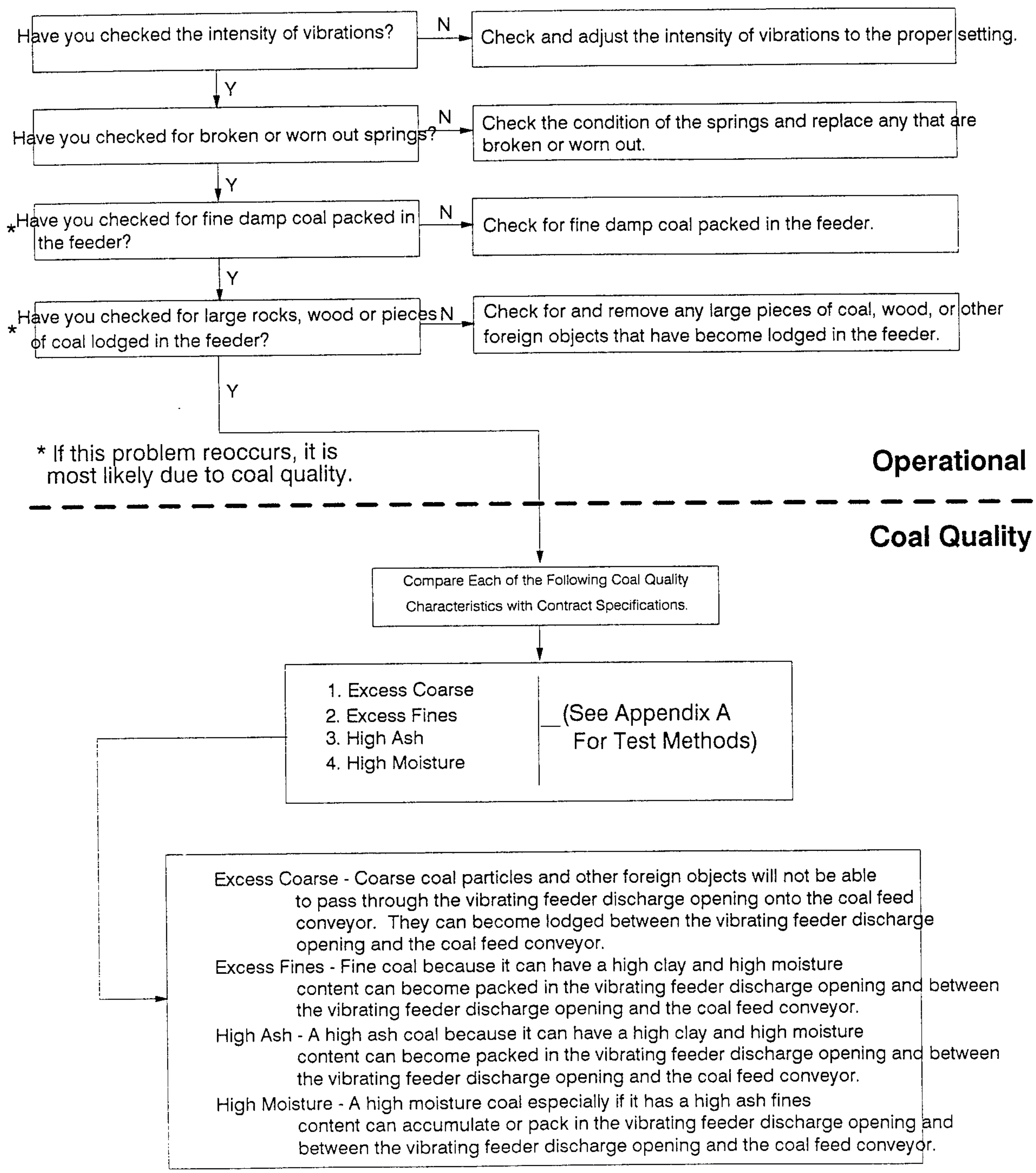


FIG5-11n/1

FIGURE 5-12: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Vibrating Feeder)

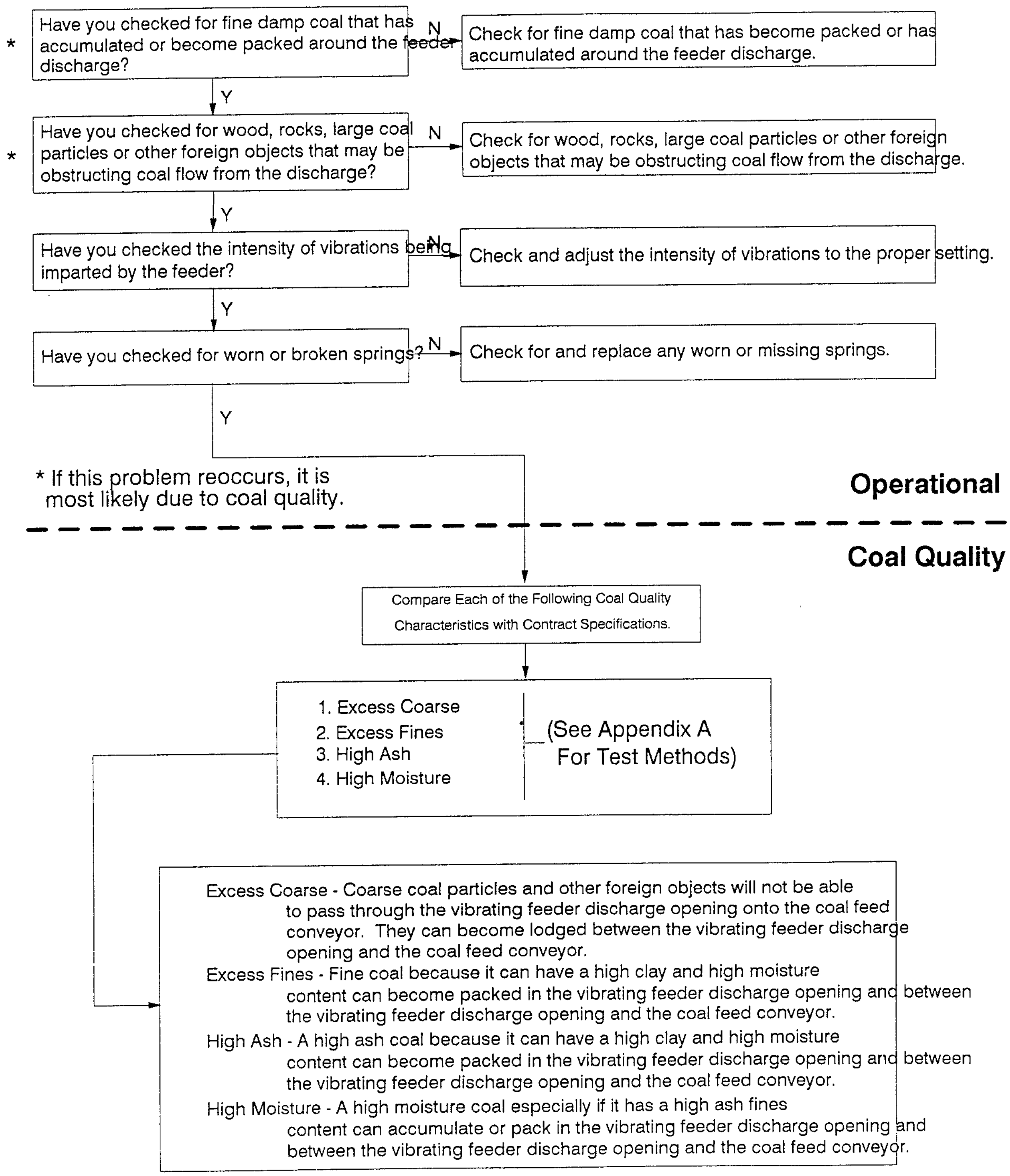


FIG5-12n/1

FIGURE 5-13: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim
(Vibrating Feeder)

Have you checked the intensity of vibrations being imparted by the feeder? — N → Check and adjust the feeder vibration intensity to the proper setting.

↓ Y

Have you checked for broken or worn out springs? — N → Check and replace any broken or worn out springs.

↓ Y

* Have you checked for fine damp coal packed in the feeder? — N → Check and remove any fine damp coal packed in the feeder.

↓ Y

* Have you checked for large rocks, wood or large coal particles lodged in feeder? — N → Check and remove any rocks,wood, large coal particles that may have become lodged in the feeder.

↓ Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

↓

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

↓

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the vibrating feeder discharge opening onto the coal feed conveyor. They can become lodged between the vibrating feeder discharge opening and the coal feed conveyor.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the vibrating feeder discharge opening and between the vibrating feeder discharge opening and the coal feed conveyor.

FIG5-13n/1

FIGURE 5-14: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Screw Feeder)

* Have you checked to see that fine damp coal is not packed in between the screw and the casing?

N → Check to see that fine damp coal has not become packed in between the screw and the casing.

Y ↓

Have you checked the speed at which the screw is turning (rotating)?

N → Check and adjust the speed at which the screw is turning (rotating).

Y ↓

Do you routinely inspect and maintain the screw auger to ensure its proper working condition?

N → Inspect screw conveyor routinely.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion - Abrasion is the sandpaper effect of particles moving in contact with the screw feeder and the casing. A highly abrasive coal can therefore wear away the metal surfaces of the screw feeder.

Relative Free Quartz (RFQ) - The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash - A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can wear away the metal surface of the screw feeder.

FIG5-14n/1

FIGURE 5-15: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Automatic Coal Reclaim
(Screw Feeder)

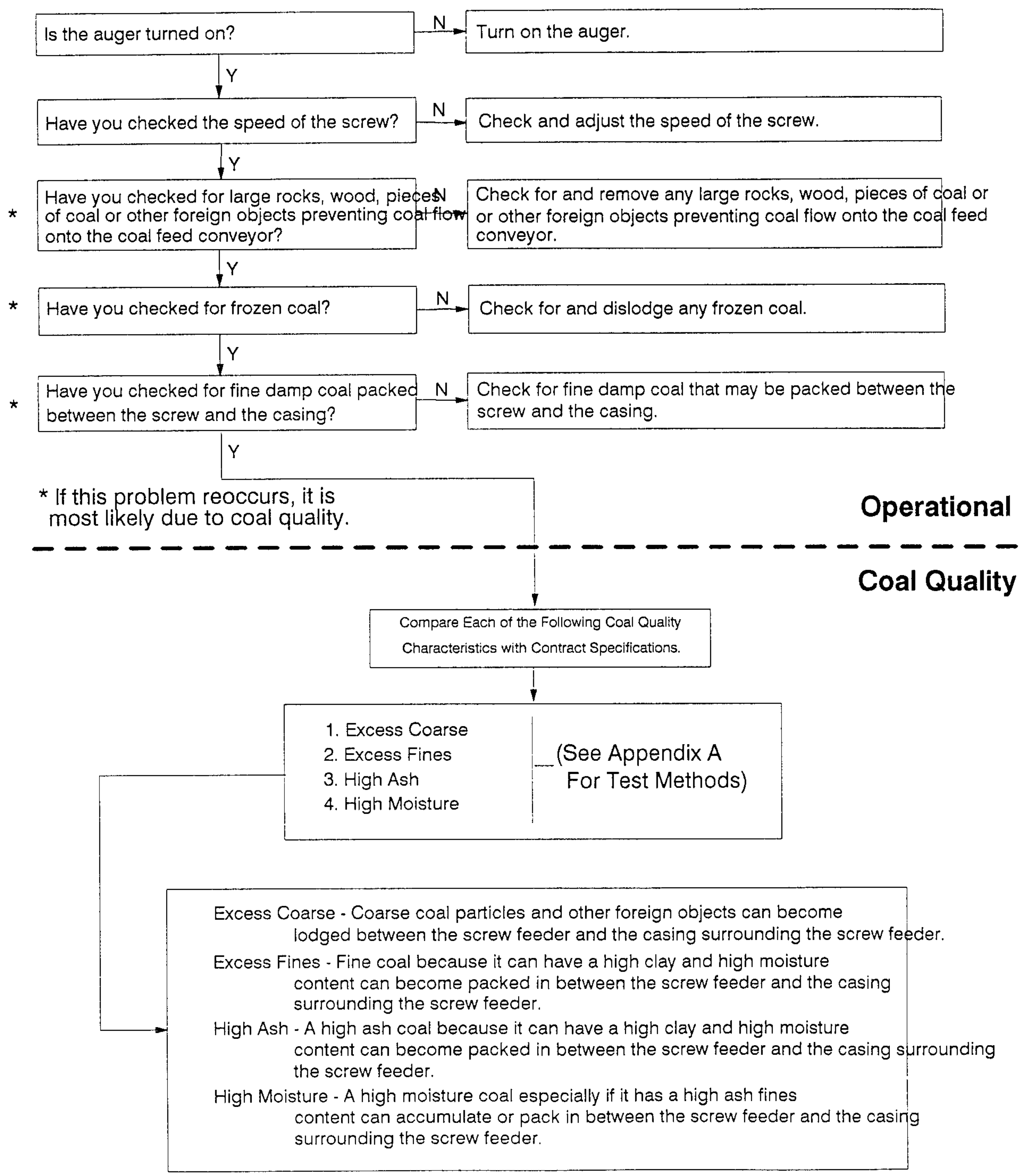


FIG5-15n/1

FIGURE 5-16: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Screw Feeder)

Is the screw auger turned on? — N → Turn the auger on.

Y

Have you checked the speed at which the screw is turning (rotating)? — N → Check and adjust the speed at which the screw is turning (rotating).

Y

* Have you checked for large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor? — N → Check for and remove any large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor.

Y

* Have you checked for frozen coal? — N → Check for and dislodge any frozen coal.

Y

* Have you checked to see that fine damp coal is not packed in between the screw and the casing? — N → Check to see that fine damp coal has not become packed in between the screw and the casing.

Y

Do you routinely inspect and maintain the screw feeder to ensure its proper working condition? — N → Inspect the screw feeder and maintain it to ensure its proper working condition.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw feeder and the casing surrounding the screw feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw feeder and the casing surrounding the screw feeder.

FIG5-16n/1

FIGURE 5-17: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Automatic Coal Reclaim
(Screw Feeder)

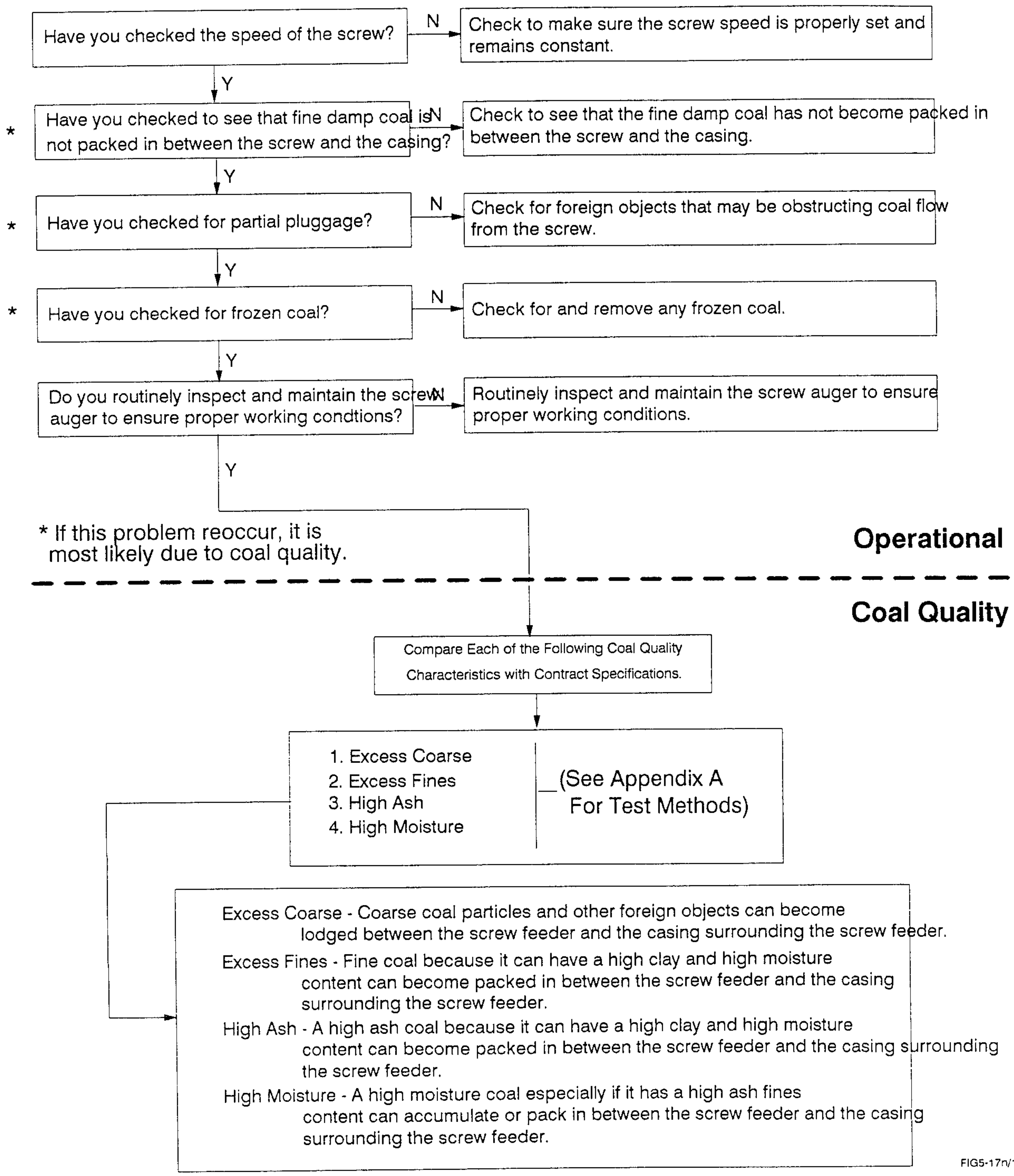


FIG5-17n/1

FIGURE 5-18: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Reciprocating Feeder)

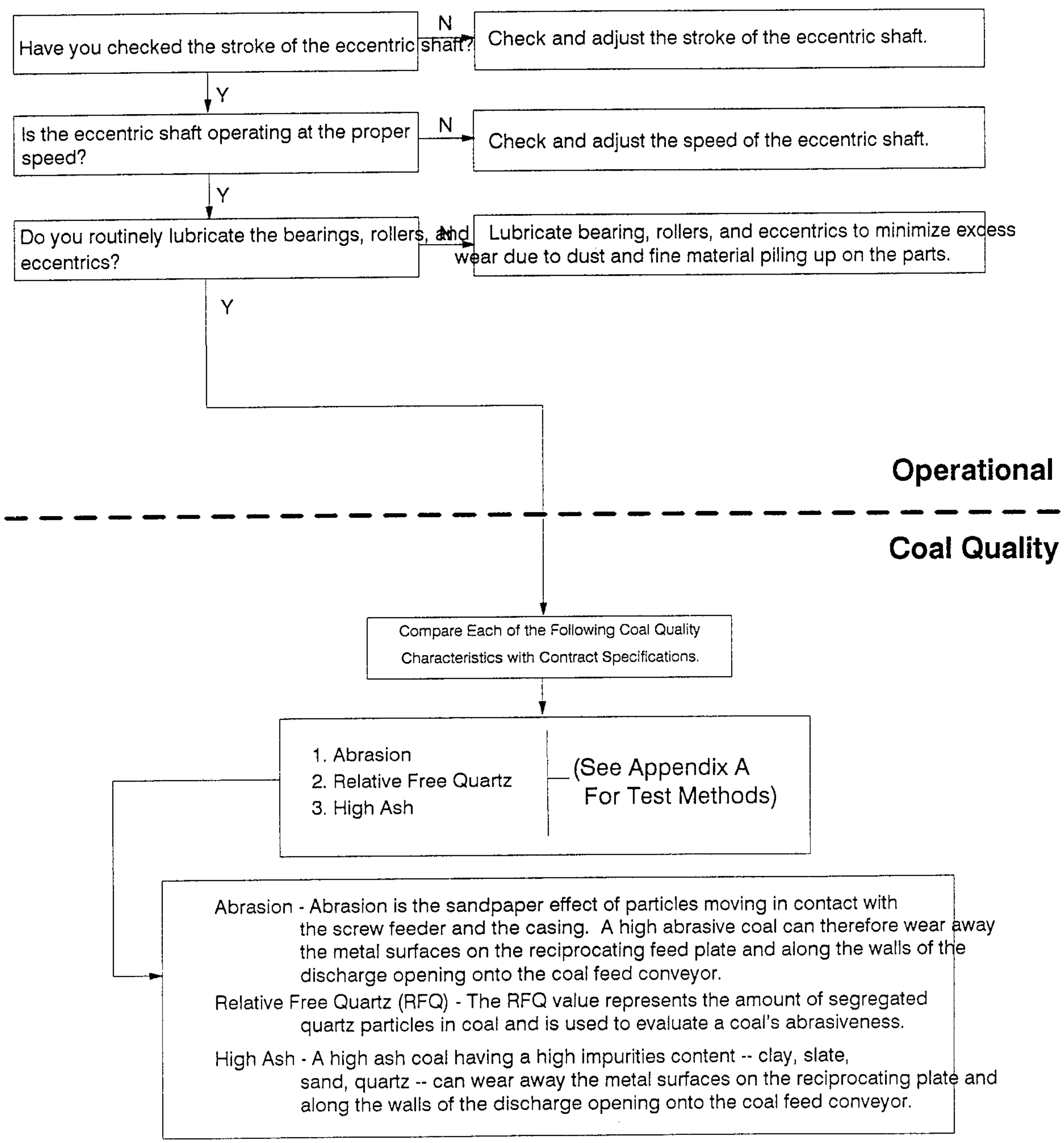


FIG5-18n/1

FIGURE 5-19: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Reciprocating Feeder)

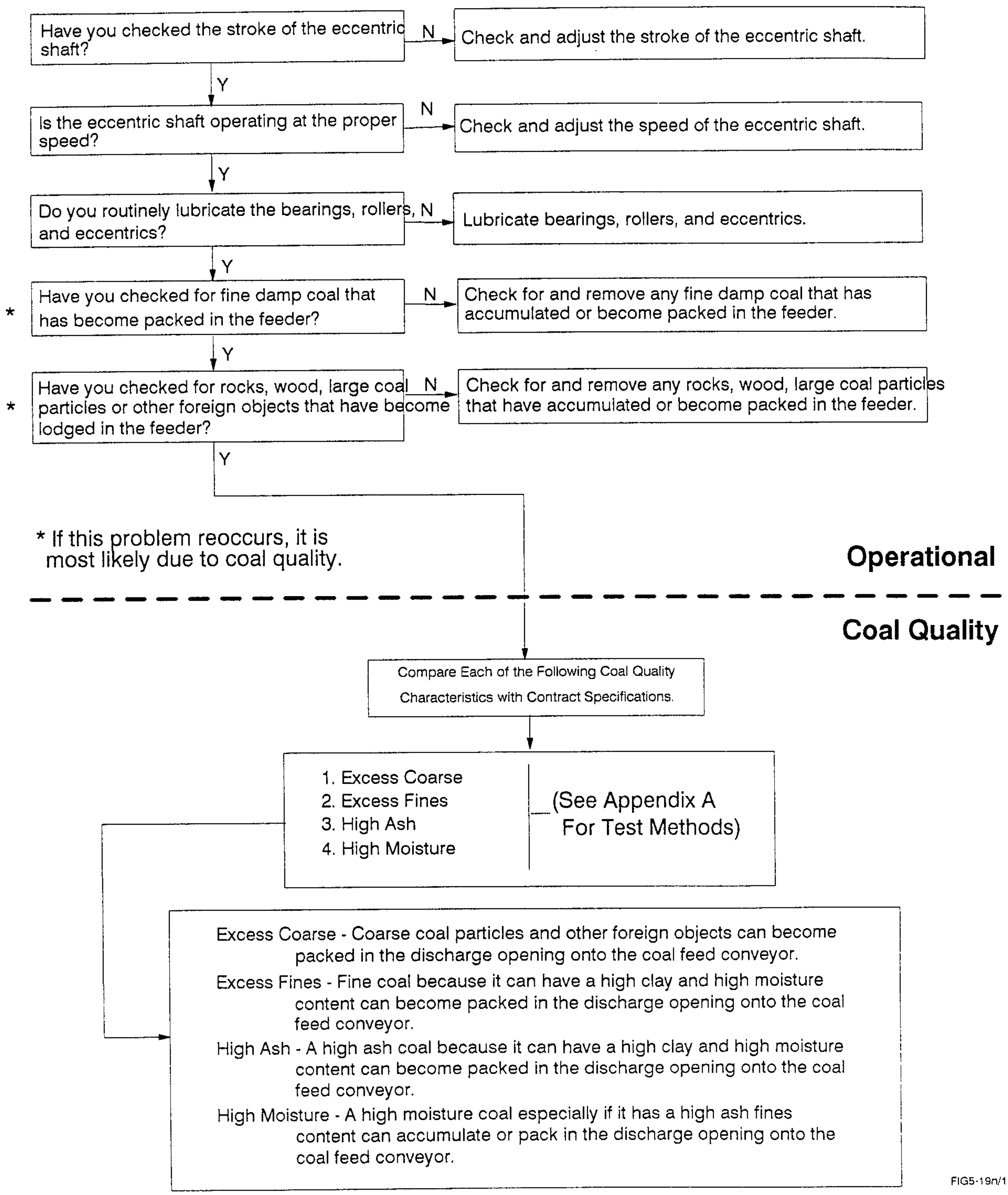


FIG5-19n/1

FIGURE 5-20: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Reciprocating Feeder)

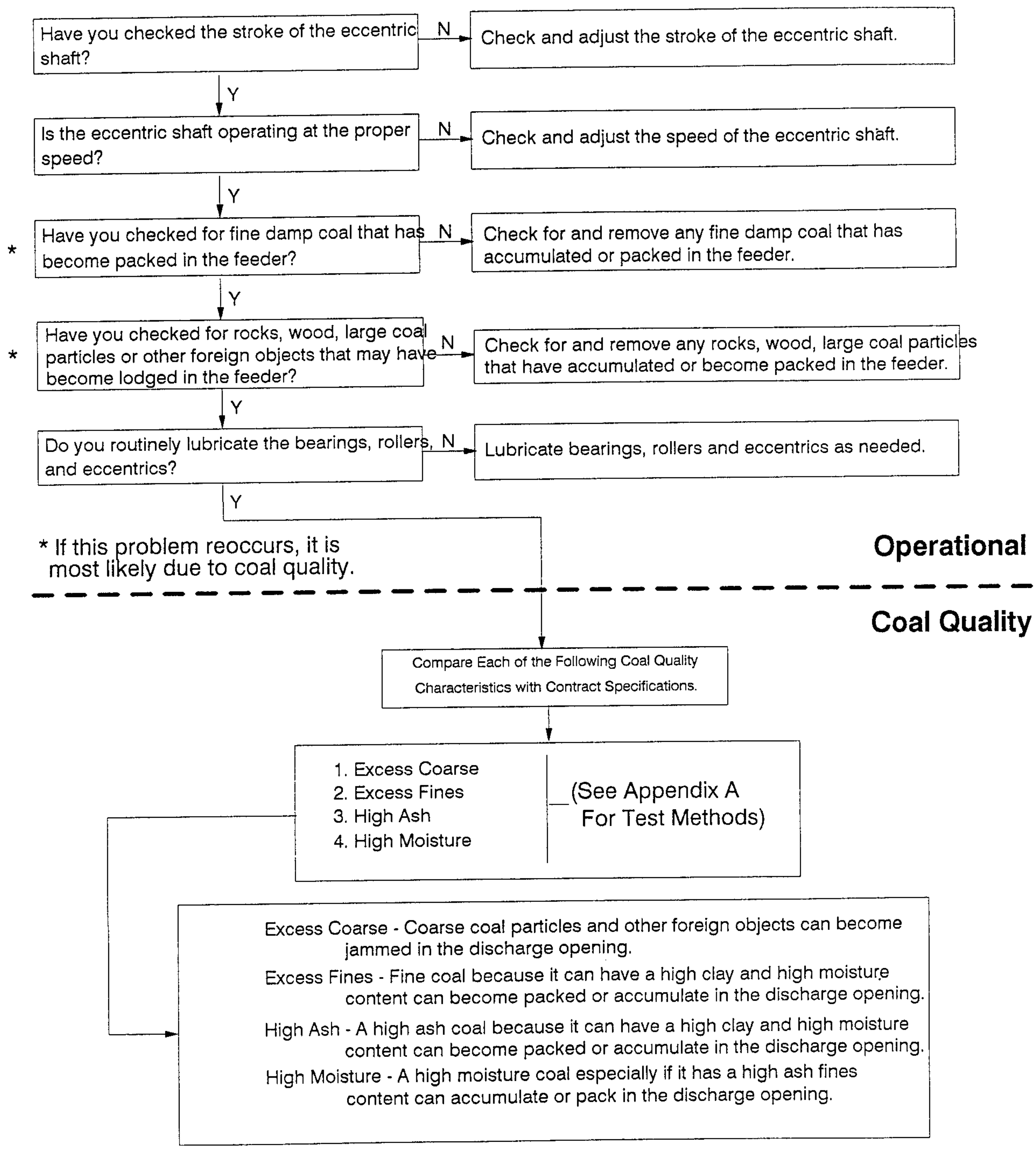


FIG5-20n/1

FIGURE 5-21: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Reciprocating Feeder)

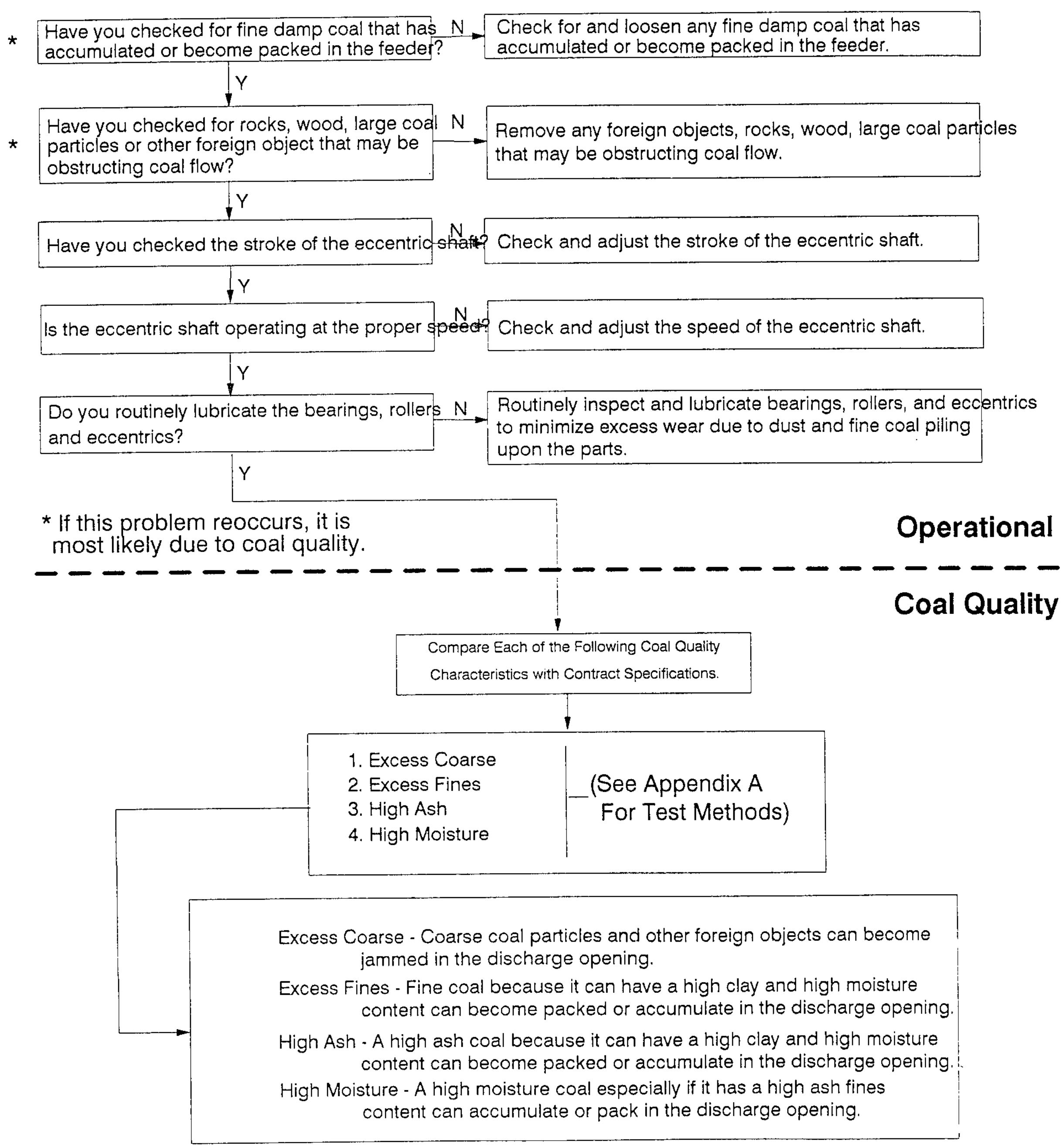


FIG5-21n/1

FIGURE 5-22: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Feed Conveyor (Belt Conveyor)

Have you checked the alignment of all parts of the conveyor setup?	N	Check the alignment of all parts of the conveyor set-up -- conveyor belt, idlers, take ups, belt conveyor drives.
Y ↓		
Have you checked to see that each part of the conveyor set-up is firmly set?	N	Check to see that each part of the conveyor system is firmly set so that it will not rock or get out of alignment.
Y ↓		
Have you checked the belt tension?	N	Check and adjust the belt tension.
Y ↓		
Do you properly and systematically lubricate the entire conveyor belt system?	N	Lubricate as necessary the entire conveyor belt system.
Y ↓		
Have you checked for frozen belt idlers?	N	Check for frozen belt idlers.
Y ↓		
Are all idlers, drive terminals and pulleys, and belt surface maintained with a clean surface?	N	Maintain all idlers, pulleys, drive terminals, and the belt surface with a clean surface for belt alignment and long life.
Y ↓		
Does the conveyor belt sag between carrying idlers?	Y	Adjust idler spacing and belt tension.
N ↓		
Have you checked the belt speed?	N	Check belt speed and adjust to proper setting.
Y ↓		

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion - Abrasion is the sandpaper effect of particles moving in contact with the belt conveyor. A highly abrasive coal can therefore wear away the belt surface.

Relative Free Quartz (RFQ) - The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash - A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can rupture and wear away the belt surface.

FIG5-22n/1

FIGURE 5-23: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Feed Conveyor
(Belt Conveyor)

* Have you checked for large coal particles that have become lodged between idlers and the belt?

N → Check for large coal particles, rocks, wood, other foreign objects that have become lodged between idlers and belt

Y ↓

Have you checked to see that the belt is in proper working condition?

N → Check to see that belt is in proper working condition
NOTE: See Operational Section of Figure 5-6.

Y ↓

Have you checked the automatic coal recaim for pluggage?

N → Check your automatic coal reclaim for pluggage.
NOTE: See figure 5-5 to identify the type of automatic coal reclaim system you have and follow the operational section of the corresponding logic diagram for pluggage.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - If the belt is overloaded and coarse coal particles spill over carriers, deck, and onto the return belt, the coarse coal particles can become lodged between the belt and idlers.

Excess Fines - If the belt is overloaded and fine coal particles spill over carriers, deck and onto return belt, fine coal particles because they can have a high clay and high moisture content can accumulate on the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

FIG5-23n/1

FIGURE 5-24: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Belt Conveyor)

Have you checked to see that coal is not spilling over the sides of the belt? — N → Check for coal spilling over the sides of the belt.

Y

* Have you checked to see that fine moist coal is not sticking to the belt? — N → Check for moist fine coal sticking to the belt.

Y

Have you checked to see that the belt is in good working condition? — N → Checking the working condition of the belt. NOTE: See Operational Section Of Figure 7-6.

Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - If the belt is overloaded and coarse coal particles spill over carriers, deck, and onto the return belt, the coarse coal particles can become lodged between the belt and idlers.

Excess Fines - If the belt is overloaded and fine coal particles spill over carriers, deck and onto return belt, fine coal particles because they can have a high clay and high moisture content can accumulate on the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed or accumulate on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack on the belt or around the various parts of the belt possibly damaging the belt surface or causing the belt to run off center.

FIG5-24n/1

FIGURE 5-25: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Belt Conveyor)

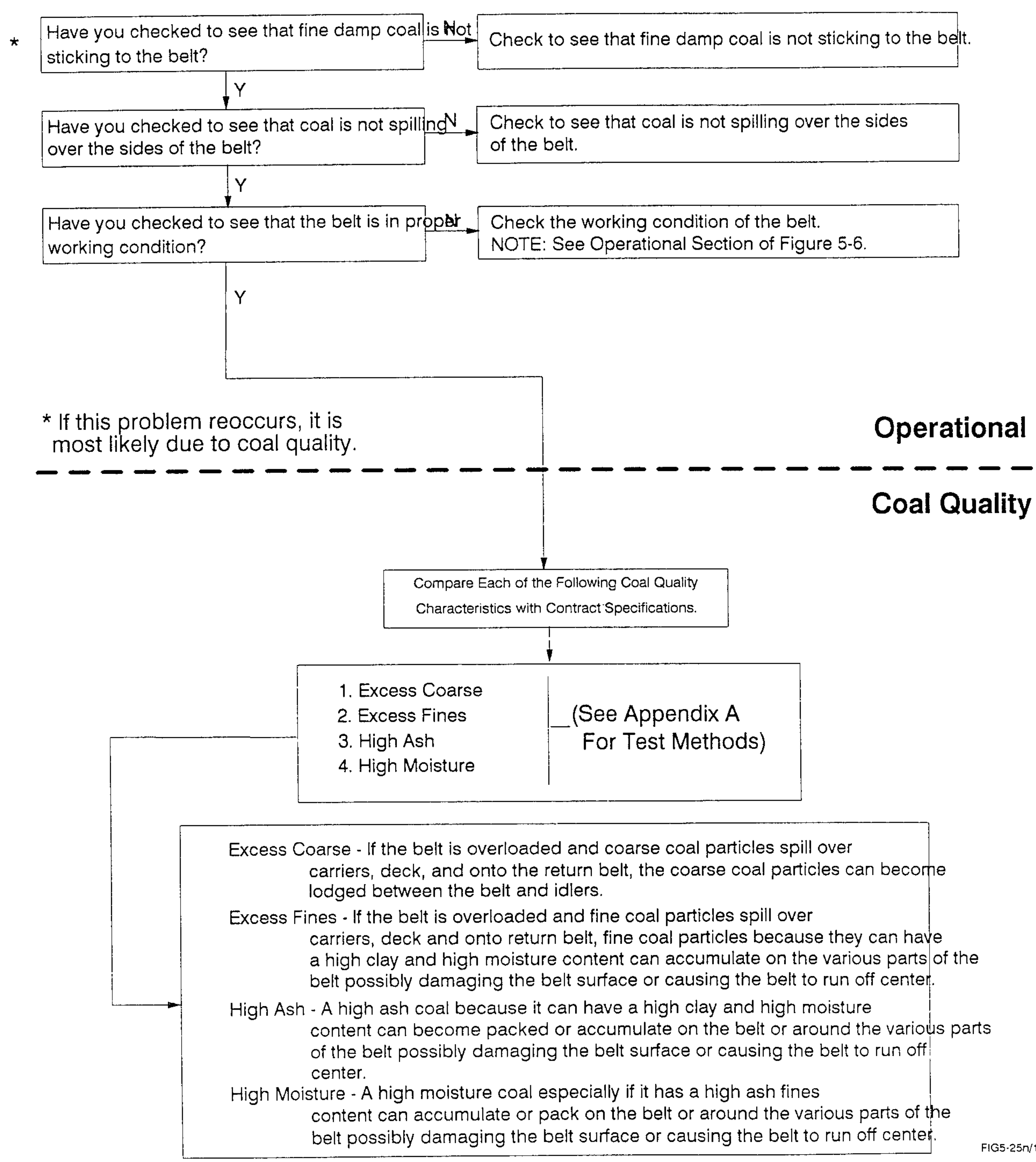


FIGURE 5-26: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear In The Coal Feed Conveyor
(Screw Conveyor)

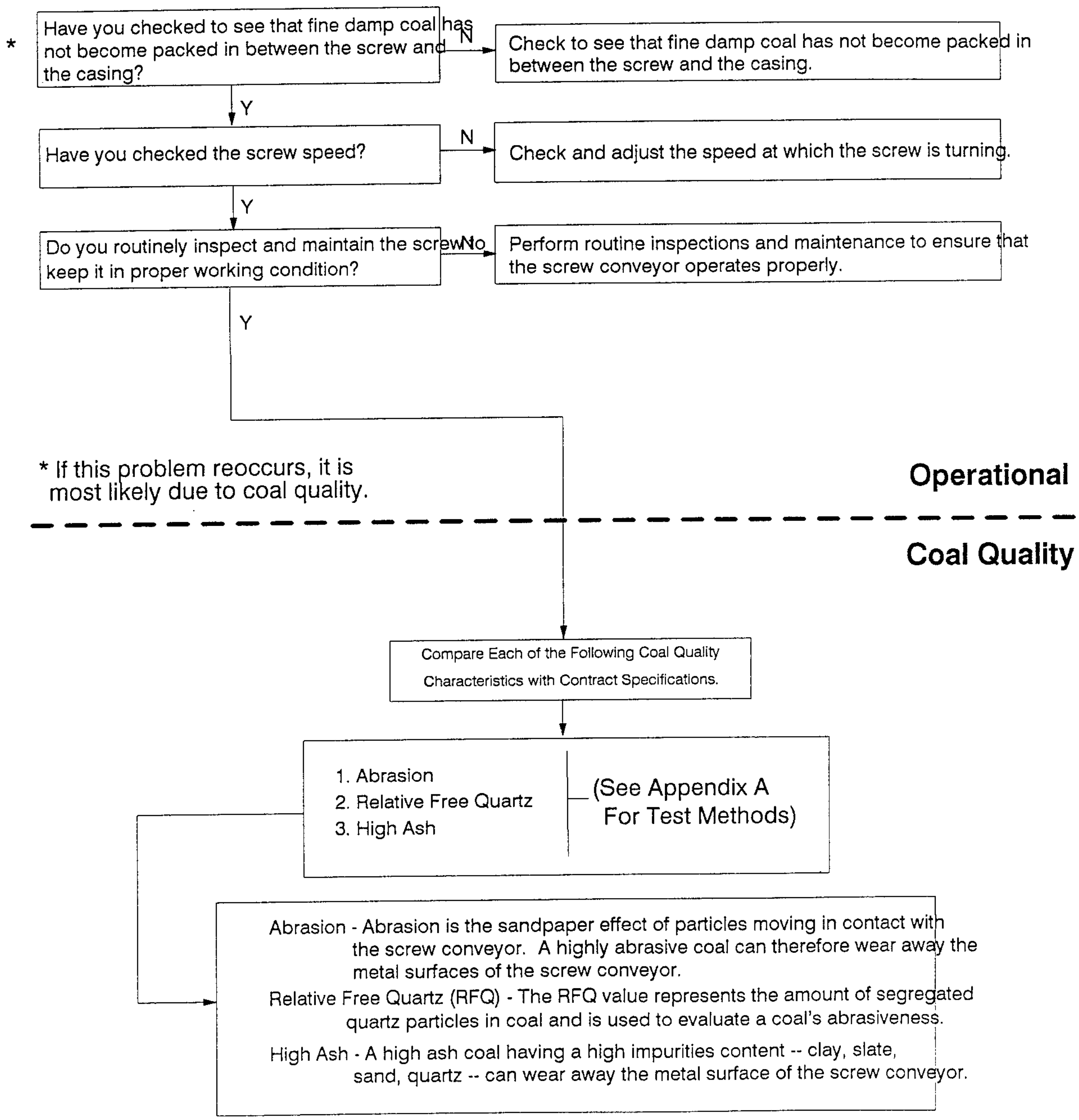


FIG5-26n/1

FIGURE 5-27: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Screw Conveyor)

* Have you checked for large rocks, wood, pieces of coal or other foreign objects that may be preventing flow of coal?
- N → Check for and remove any large rocks, wood, pieces of coal or other foreign objects preventing coal flow.
- Y ↓

Have you checked the speed of the screw?
- N → Check and adjust speed of the screw.
- Y ↓

* Have you checked for frozen coal?
- N → Check and dislodge any frozen coal.
- Y ↓

Have you checked for pluggage in your automatic coal reclaim?
- N → Inspect your automatic coal reclaim system for pluggage. Note: See Figure 5-5 to identify the type of automatic coal reclaim system you have and follow the operational section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw conveyor and the casing surrounding it.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw conveyor and the casing surrounding it.

FIG5-27n/1

FIGURE 5-28: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Screw Conveyor)

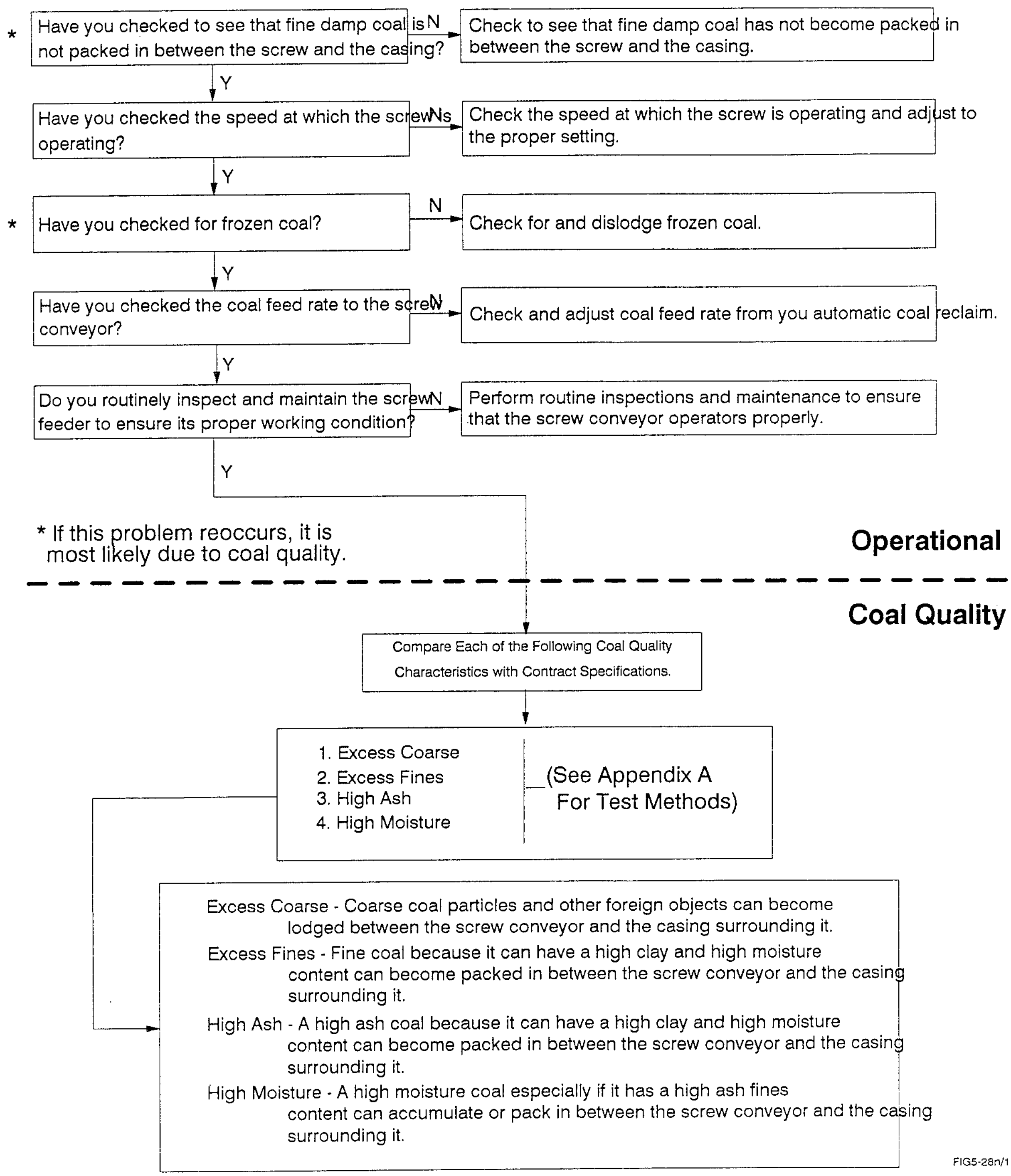


FIGURE 5-29: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Screw Conveyor)

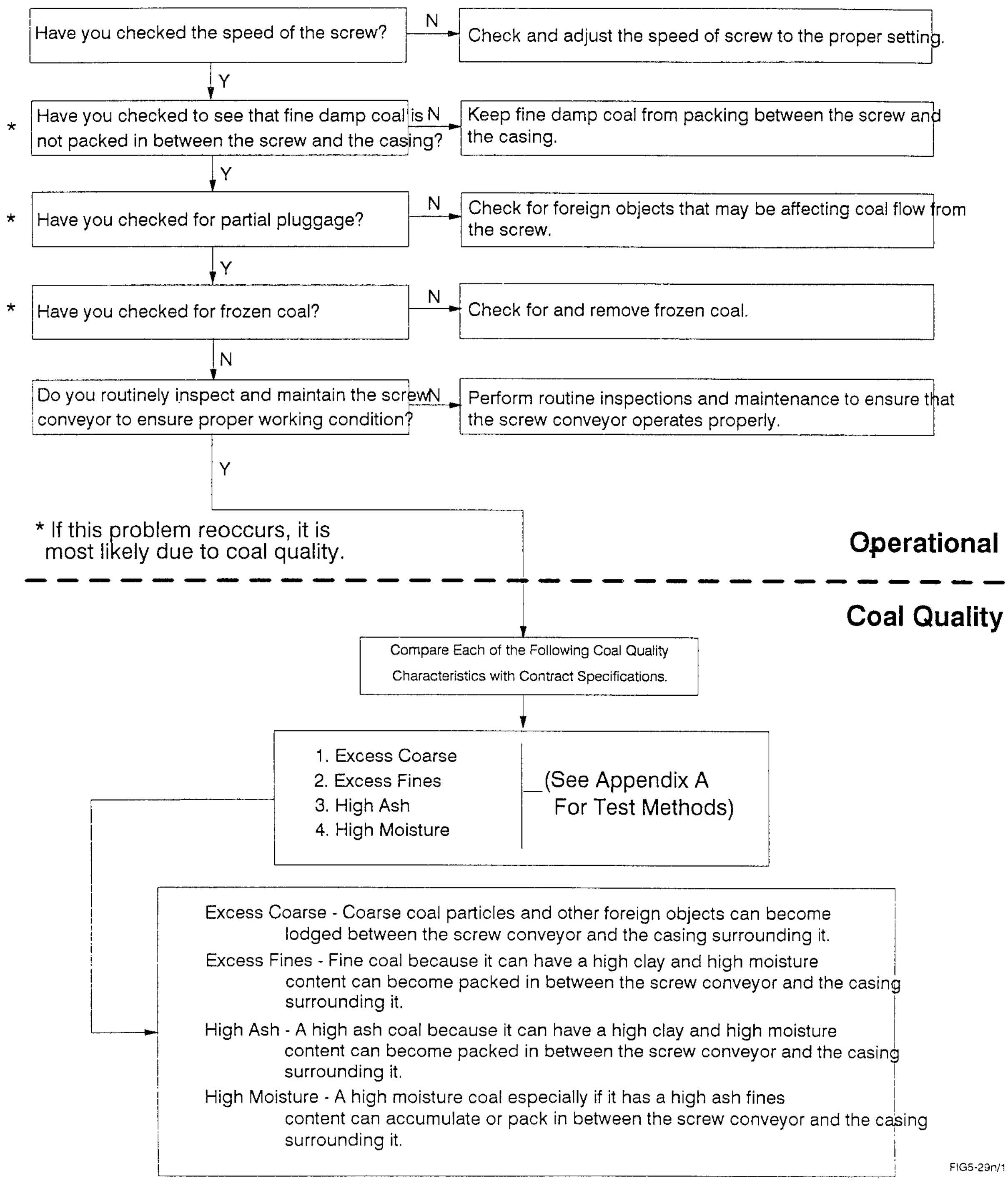


FIGURE 5-30: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor (Bucket Conveyor)

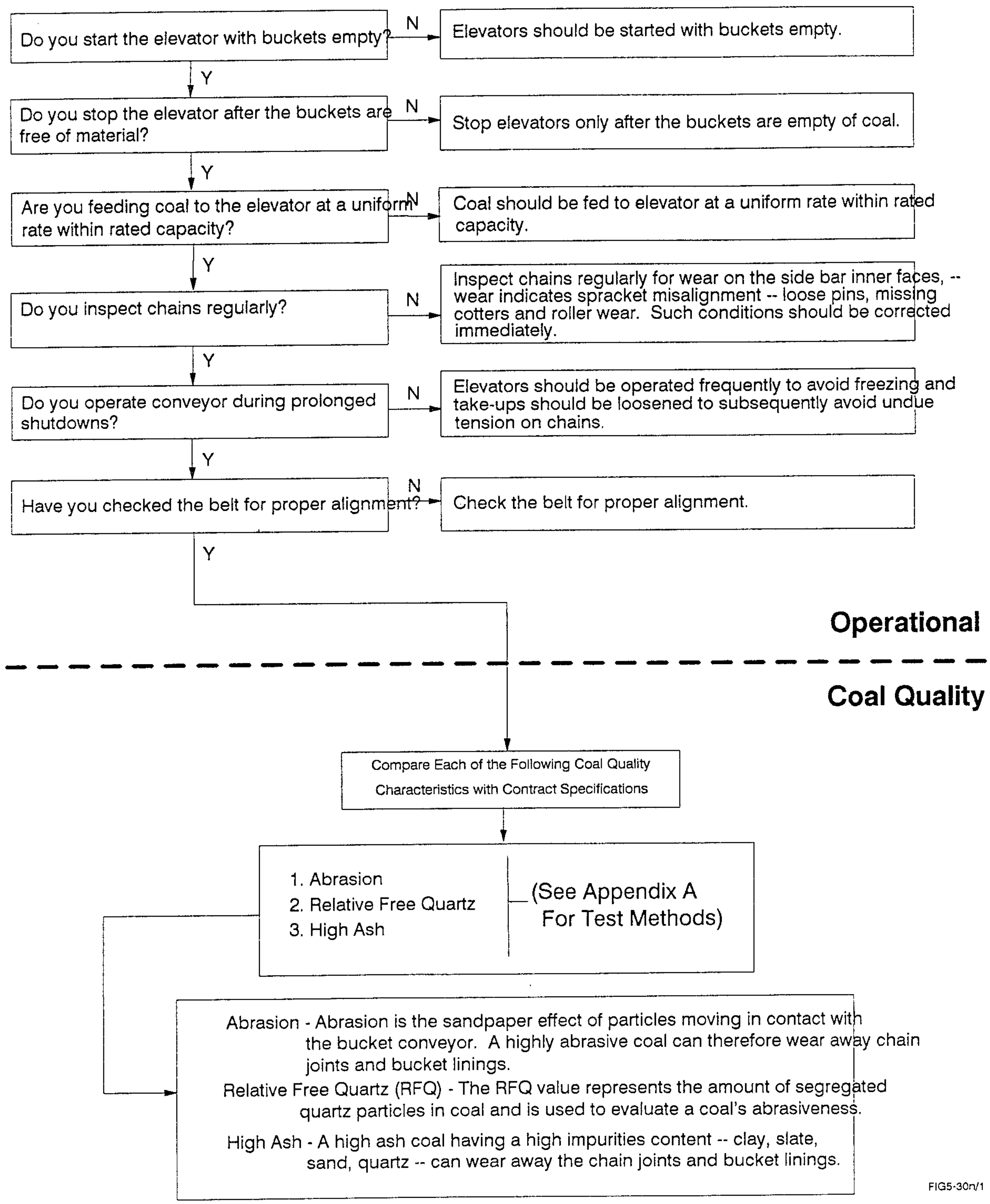


FIGURE 5-31: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Bucket Conveyor)

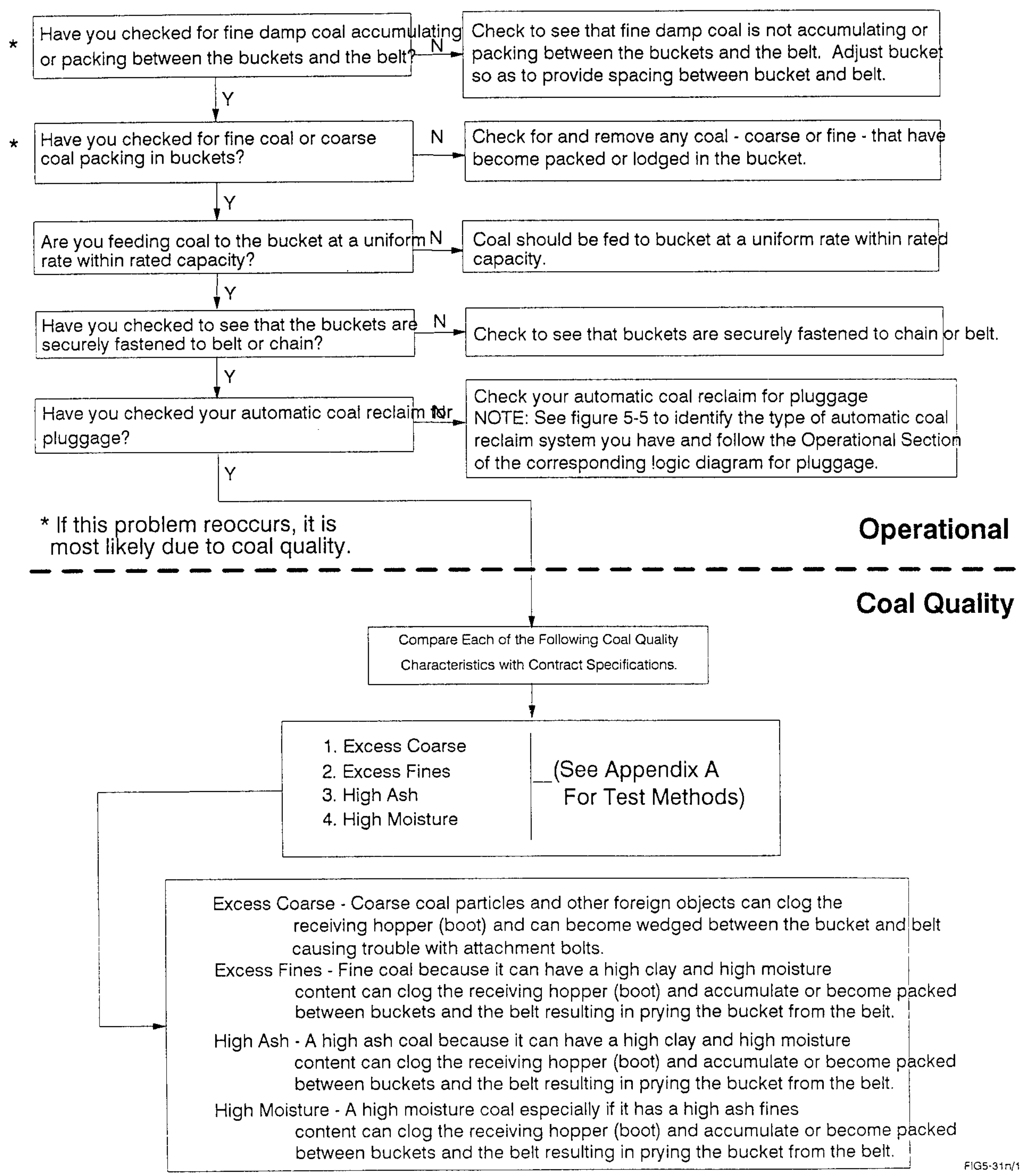


FIGURE 5-32: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Coal Feed Conveyor
(Bucket Conveyor)

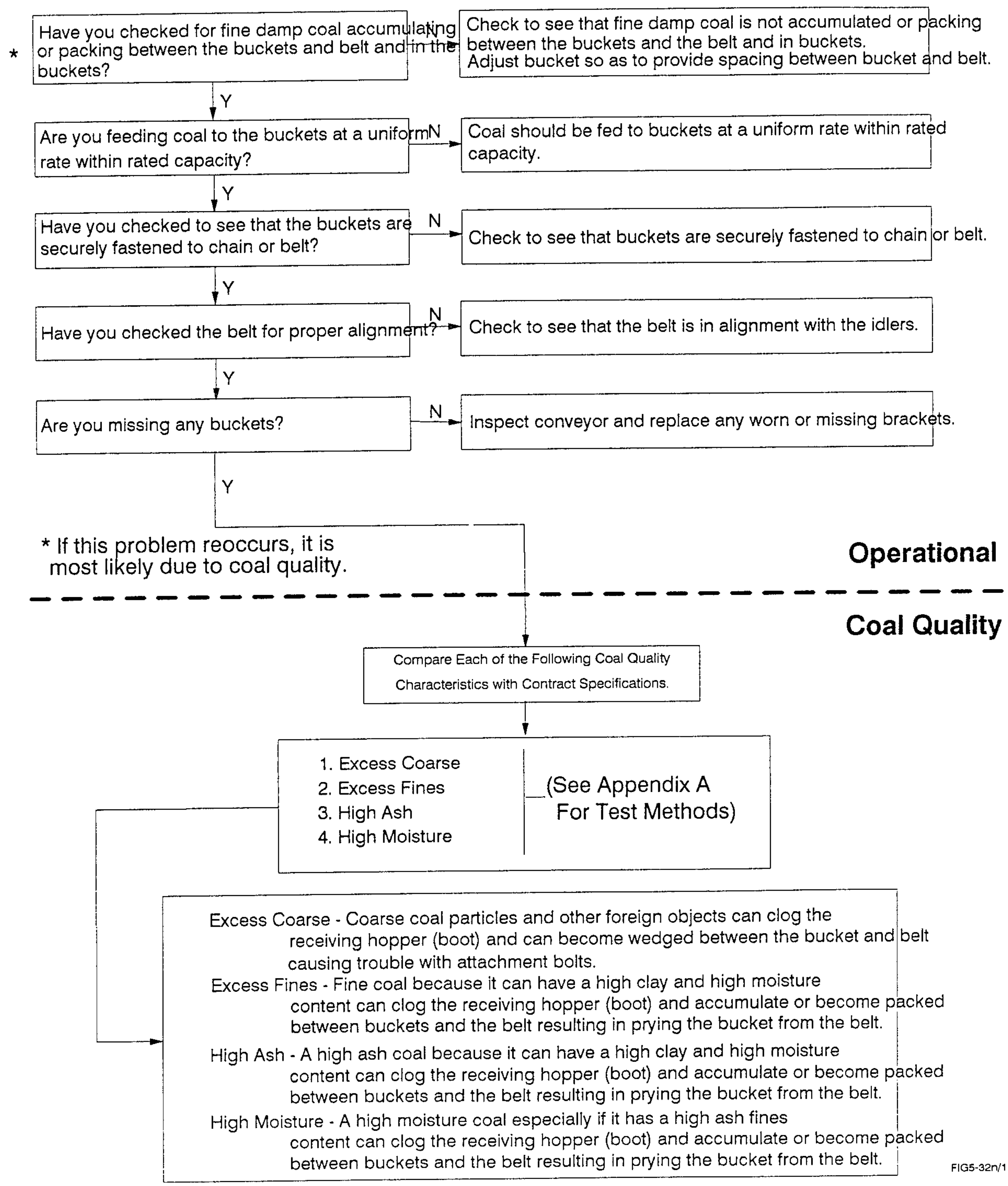


FIGURE 5-33: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

Erratic Feeding From The Coal Feed Conveyor (Bucket Conveyor)

* Have you checked for fine damp coal accumulating or packing between the buckets and the belt?
- N → Check to see that fine damp coal is not accumulating or packing between the belt and the buckets. Adjust buckets to provide spacing between the bucket and the belt.
- Y ↓

* Have you checked for fine or coarse coal packed in the buckets?
- N → Check for fine or coarse material that may be packed in the buckets.
- Y ↓

Are you feeding coal to the buckets at a uniform rate within rated capacity?
- N → Coal should be fed to the buckets at a uniform rate within rated capacity.
- Y ↓

Have you checked to see that the buckets are securely fastened?
- N → Check to see that all buckets are secure.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become wedged between the bucket and belt causing trouble with attachment bolts.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

FIG5-33n/1

FIGURE 5-34: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Coal Feed Conveyor
(Redler Conveyor)

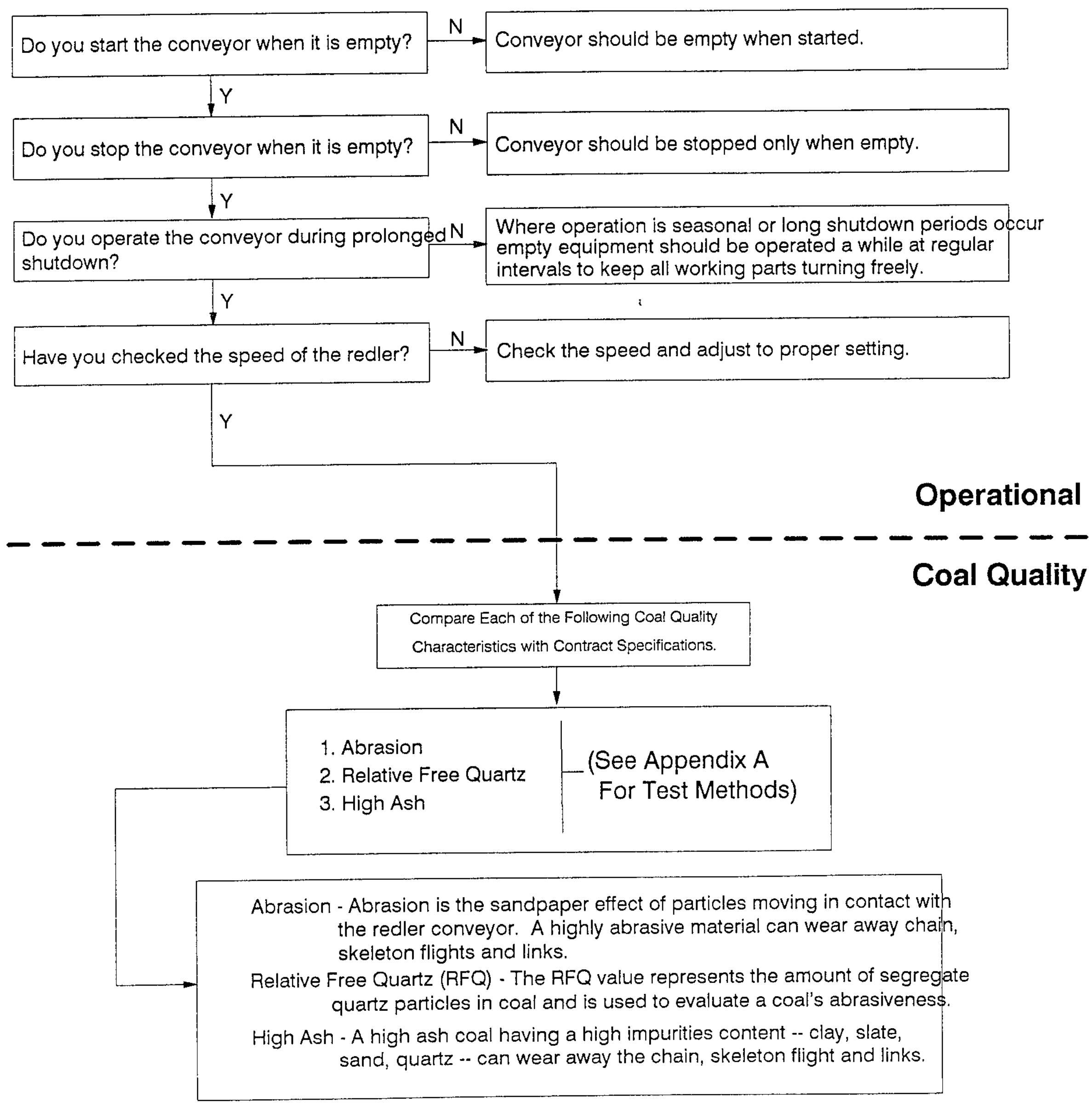


FIG5-34n/1

FIGURE 5-35: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Coal Feed Conveyor
(Redler Conveyor)

* Have you checked to see that fine damp coal has not become packed between the skeleton flights?
- N → Check to see that fine damp coal has not become packed between the skeleton flights.
- Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
- N → Check to see that coal is being fed at a uniform rate within rated capacity.
- Y ↓

* Have you checked to see that coarse material -- rocks, wood, -- have not become lodged between the duct and the skeleton flight chain?
- N → Check to see that coarse material -- rocks, wood, etc.-- have not become lodged between the duct or tube and the skeleton flight chain.
- Y ↓

Have you checked your automatic coal reclaim for pluggage?
- N → Check your automatic coal reclaim for pluggage. NOTE: See figure 5-5 to identify the type of automatic coal reclaim system you have and follow the Operational Section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG5-35n/1

FIGURE 5-36: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Redler Conveyor)

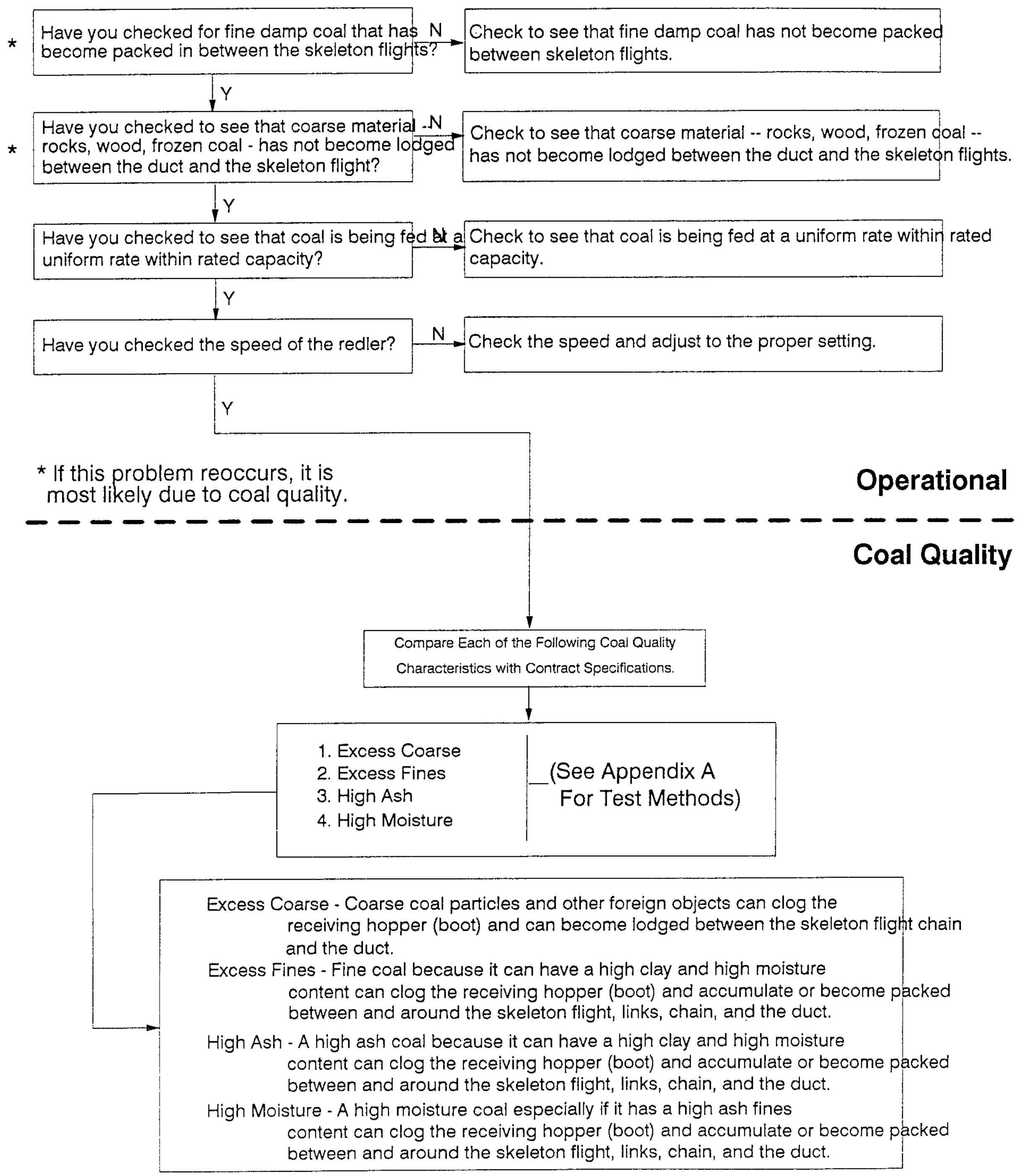


FIG5-36n/1

FIGURE 5-37: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Feed Conveyor (Redler Conveyor)

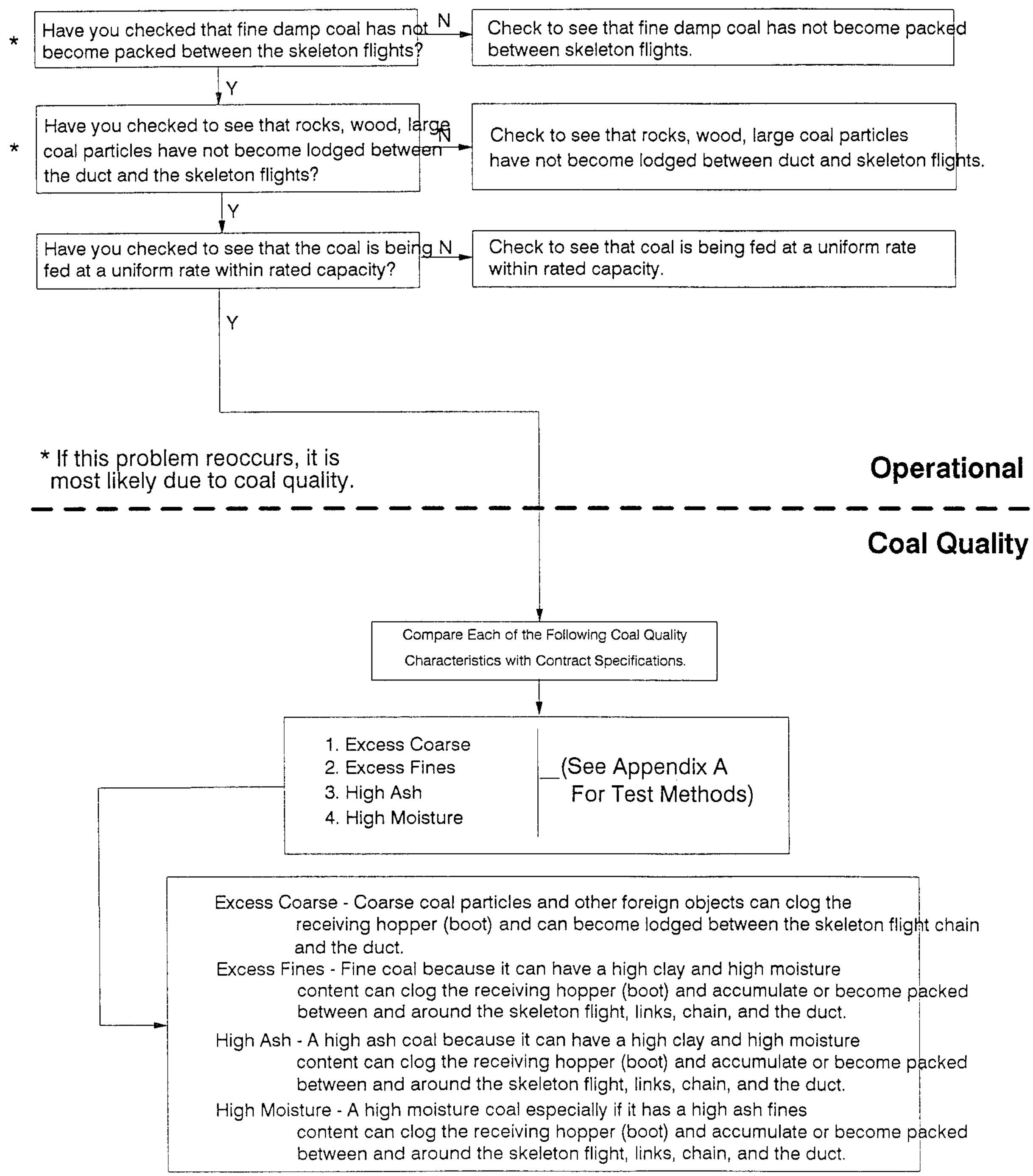


FIG5-37n/1

FIGURE 5-38: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Chute)

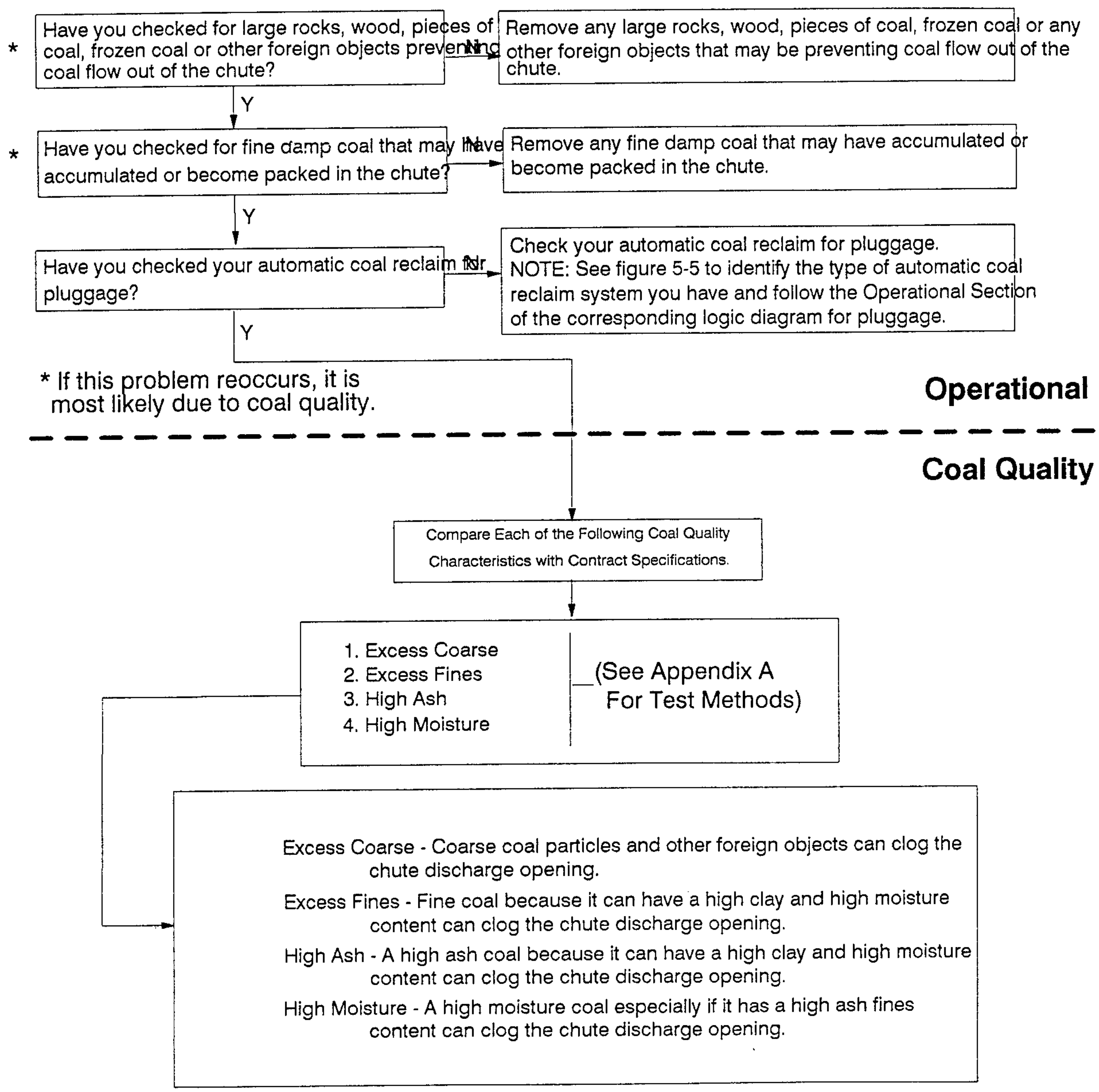


FIG5-38n/1

FIGURE 5-39: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Coal Feed Conveyor (Chute)

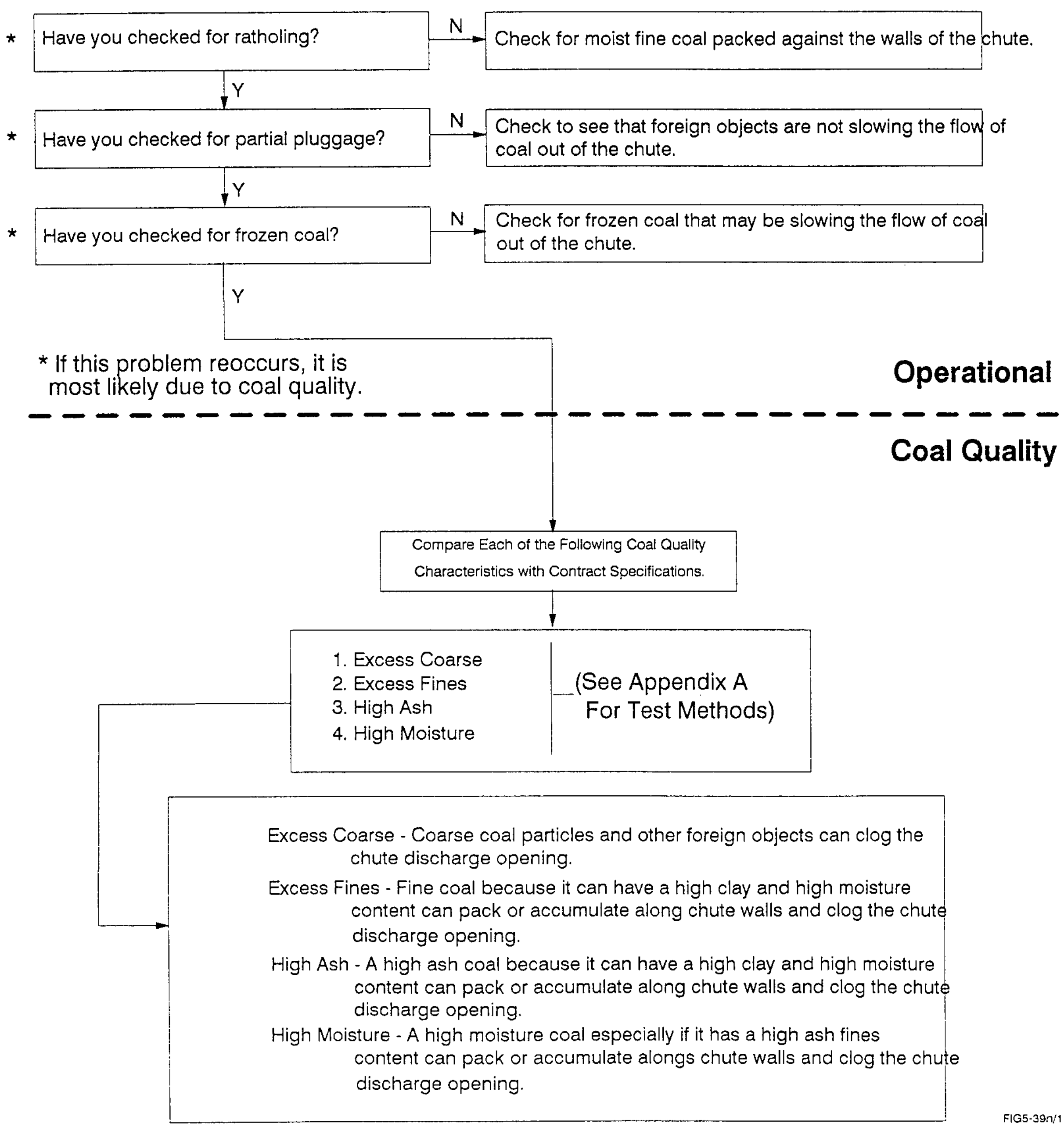


FIGURE 5-40: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Chute)

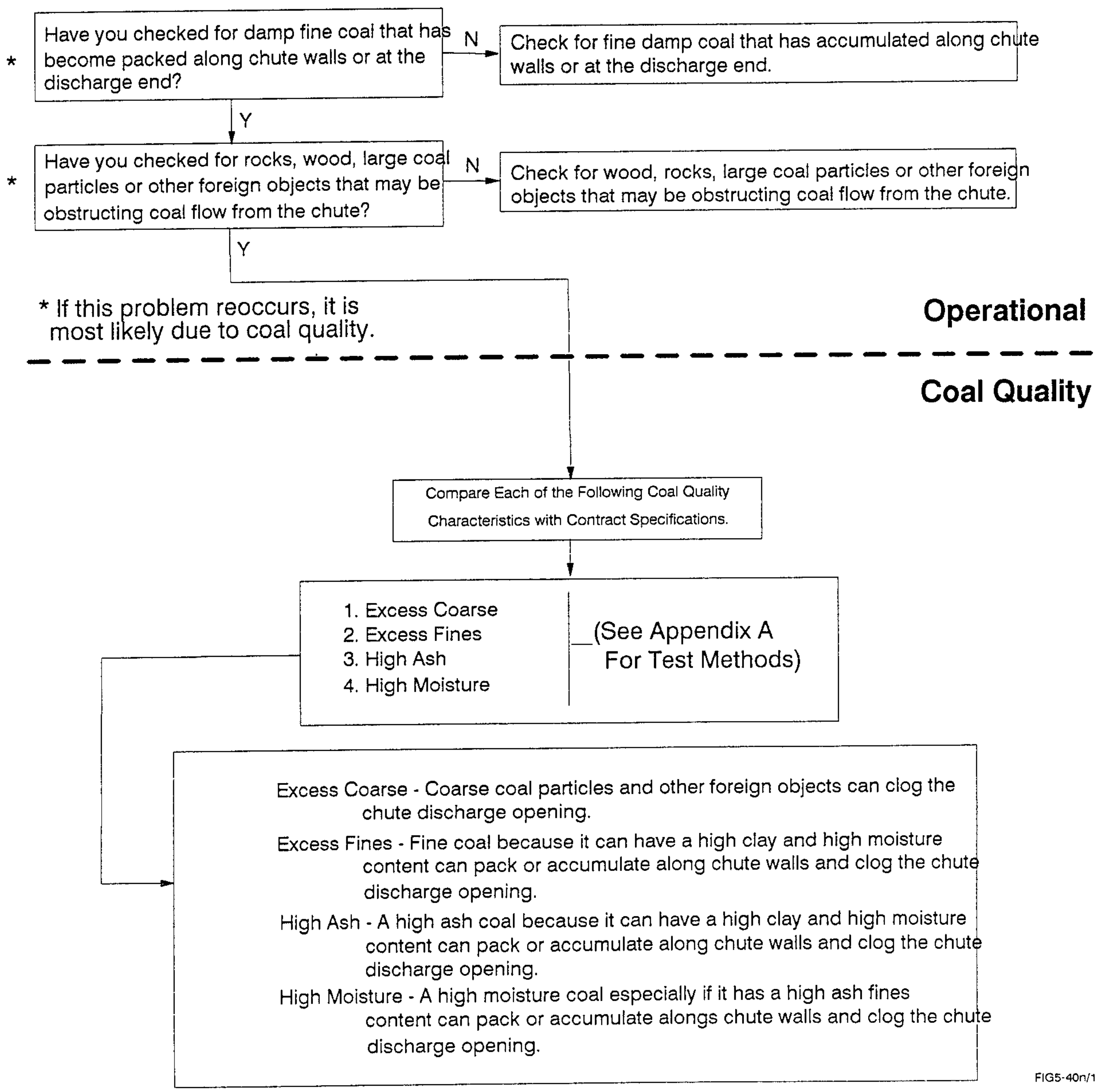


FIG5-40n/1

FIGURE 5-41: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feeders (Chute)

Operational

* Are there large rocks, wood, pieces of coal, frozen coal or other foreign objects preventing coal flow out of chute?

- N → Remove frozen coal or any foreign objects so coal flows freely from chute.
- Y ↓

Have you checked for pluggage in the coal bunker?

- N → Check for pluggage in the bunker. NOTE: See Operational Section of Figure 5-44.
- Y ↓

Have you checked for pluggage in you coal feed conveyor?

- N → Check for pluggage in the coal feed conveyor. NOTE: See figure 5-5 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.
- Y ↓

Have you checked your automatic coal reclaim for pluggage?

- N → Check for pluggage in the automatic coal reclaim. NOTE: See figure 5-5 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely is due to coal quality.

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the chute discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the chute discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the chute discharge opening.

FIG5-41n/1

FIGURE 5-42: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In the Coal Feeder (Chutes)

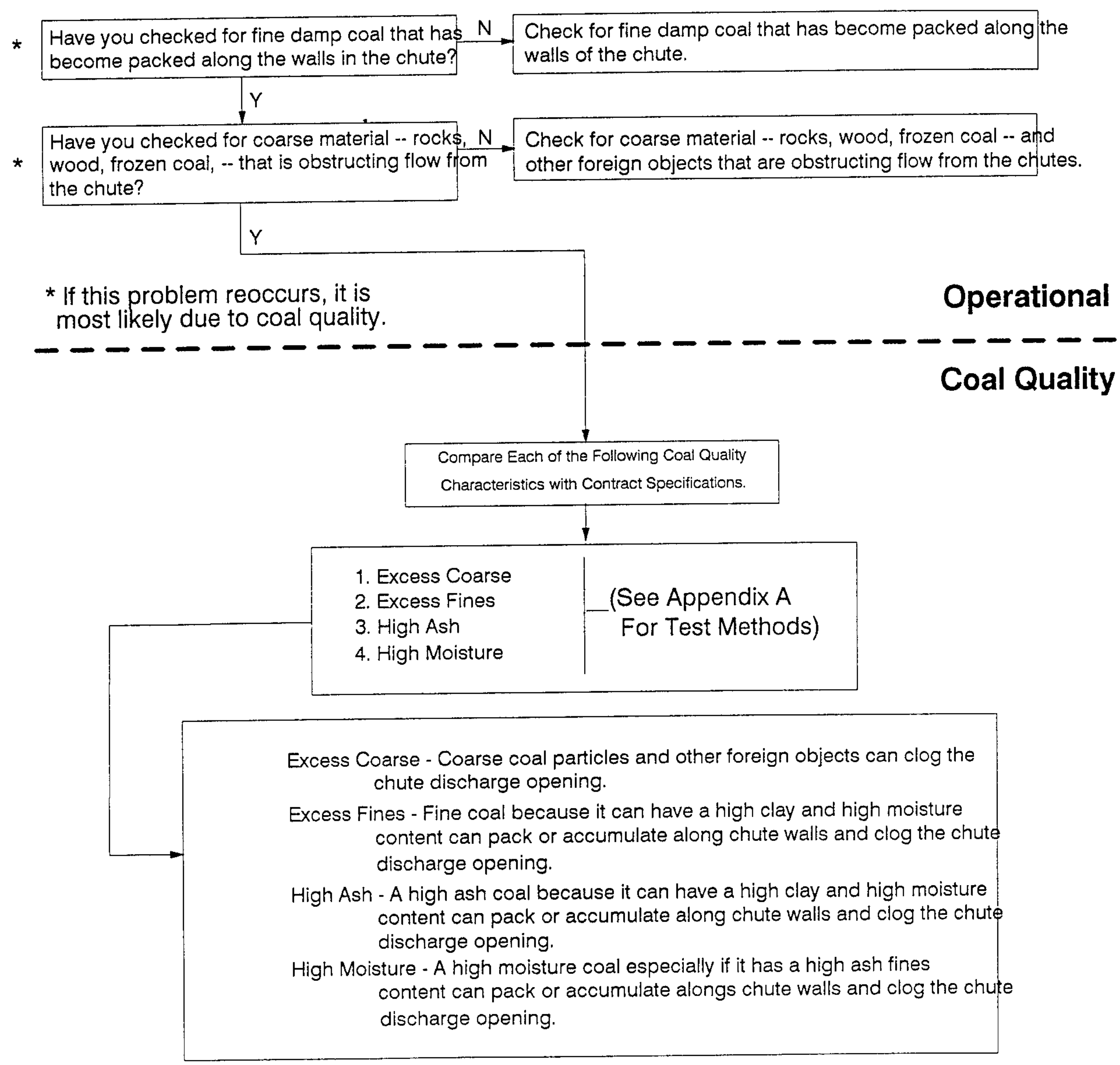


FIG5-42n/2

FIGURE 5-43: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feeder (Chutes)

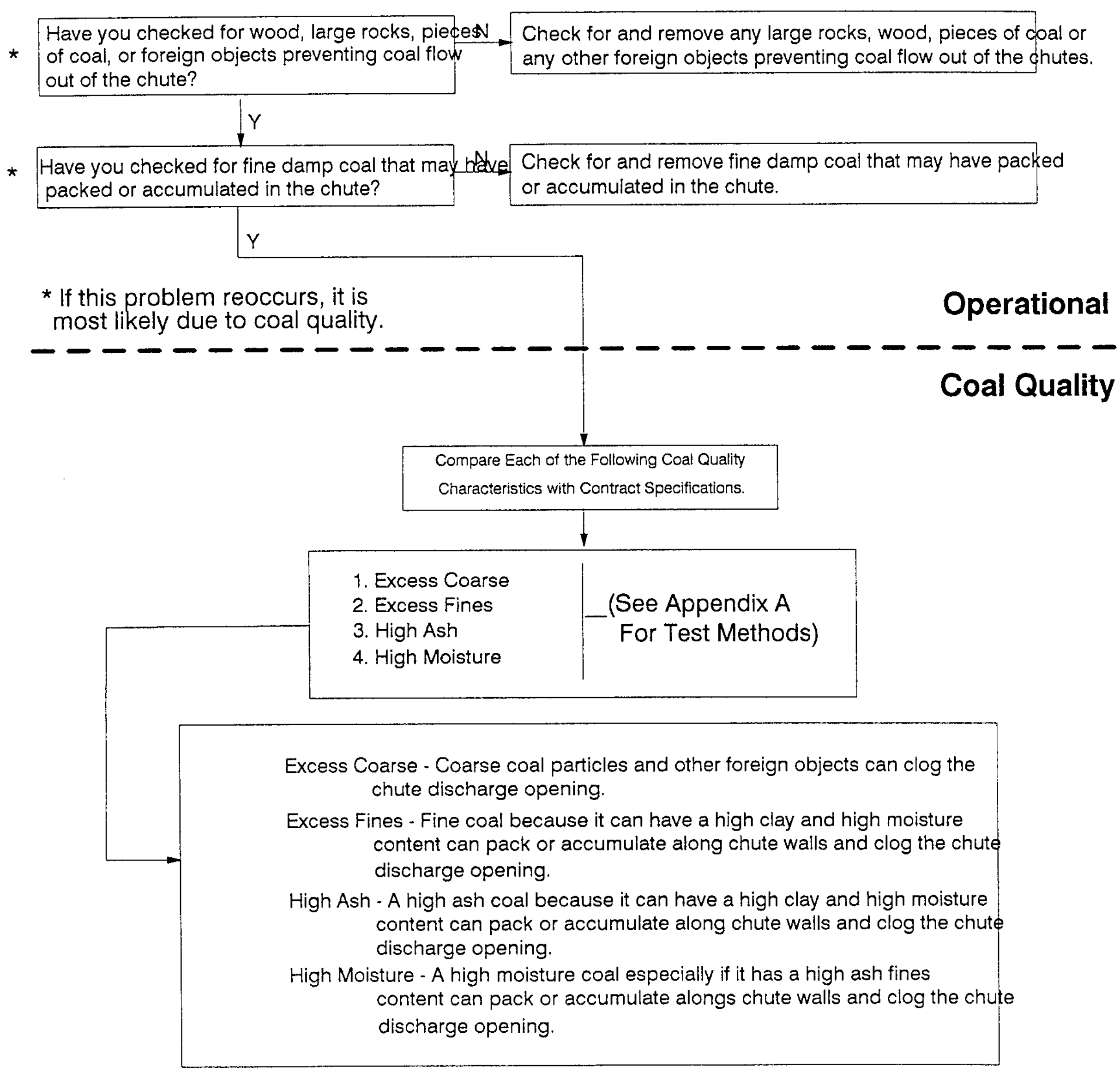


FIG5-43n/2

FIGURE 5-44: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Bunker

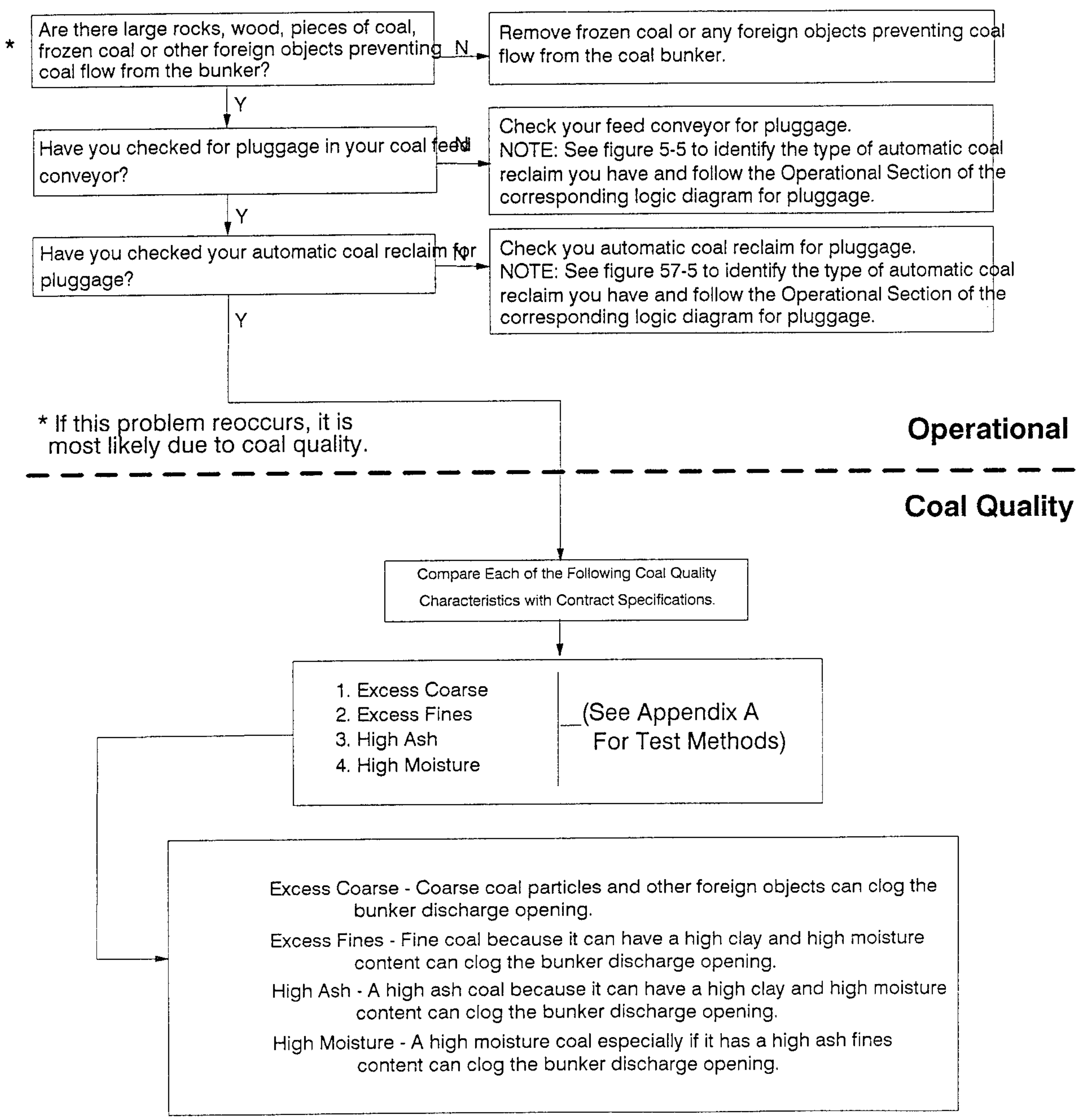


FIG5-44n/2

FIGURE 5-45: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Bunker

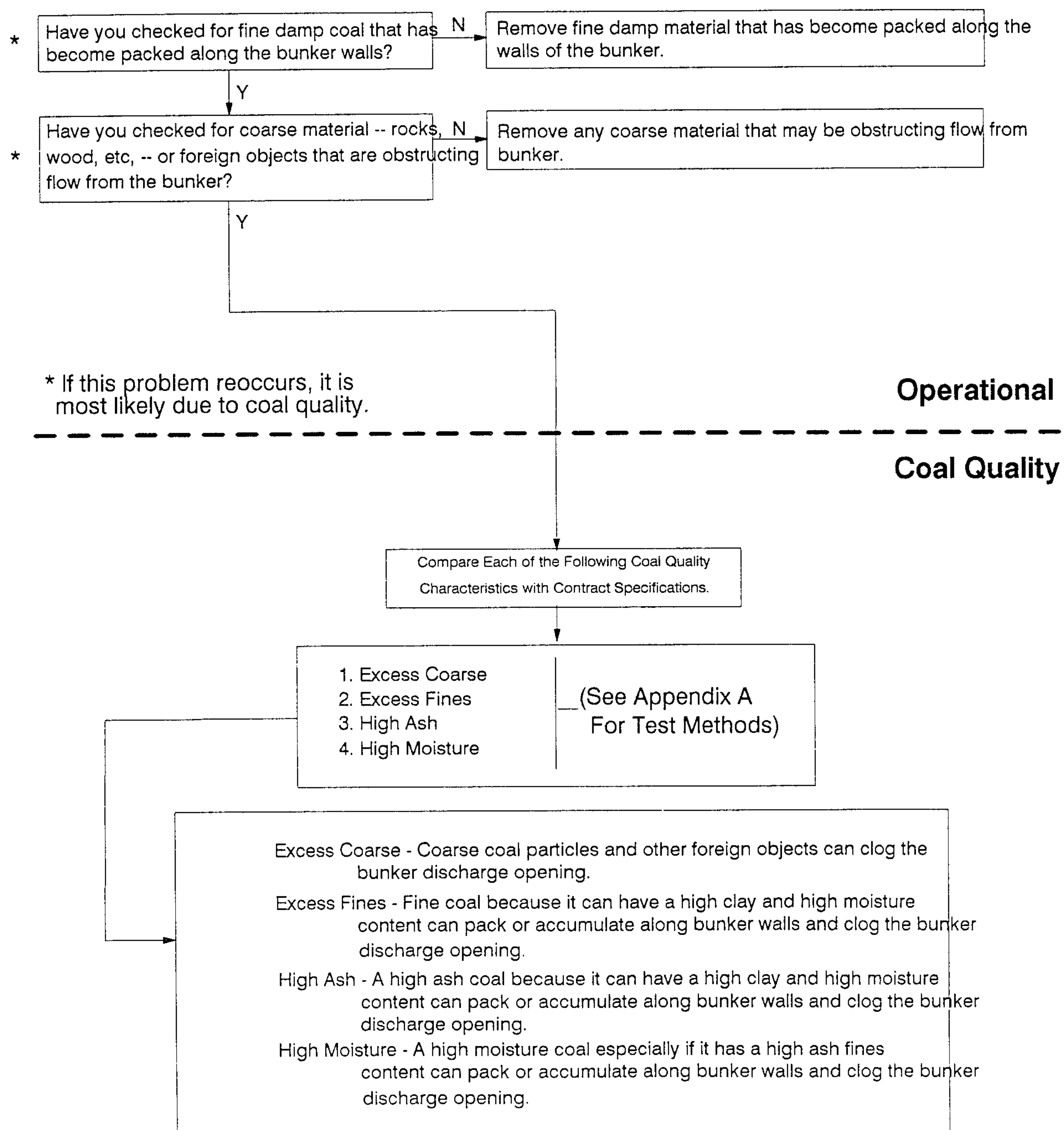


FIG5-45n/2

FIGURE 5-46: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Bunker

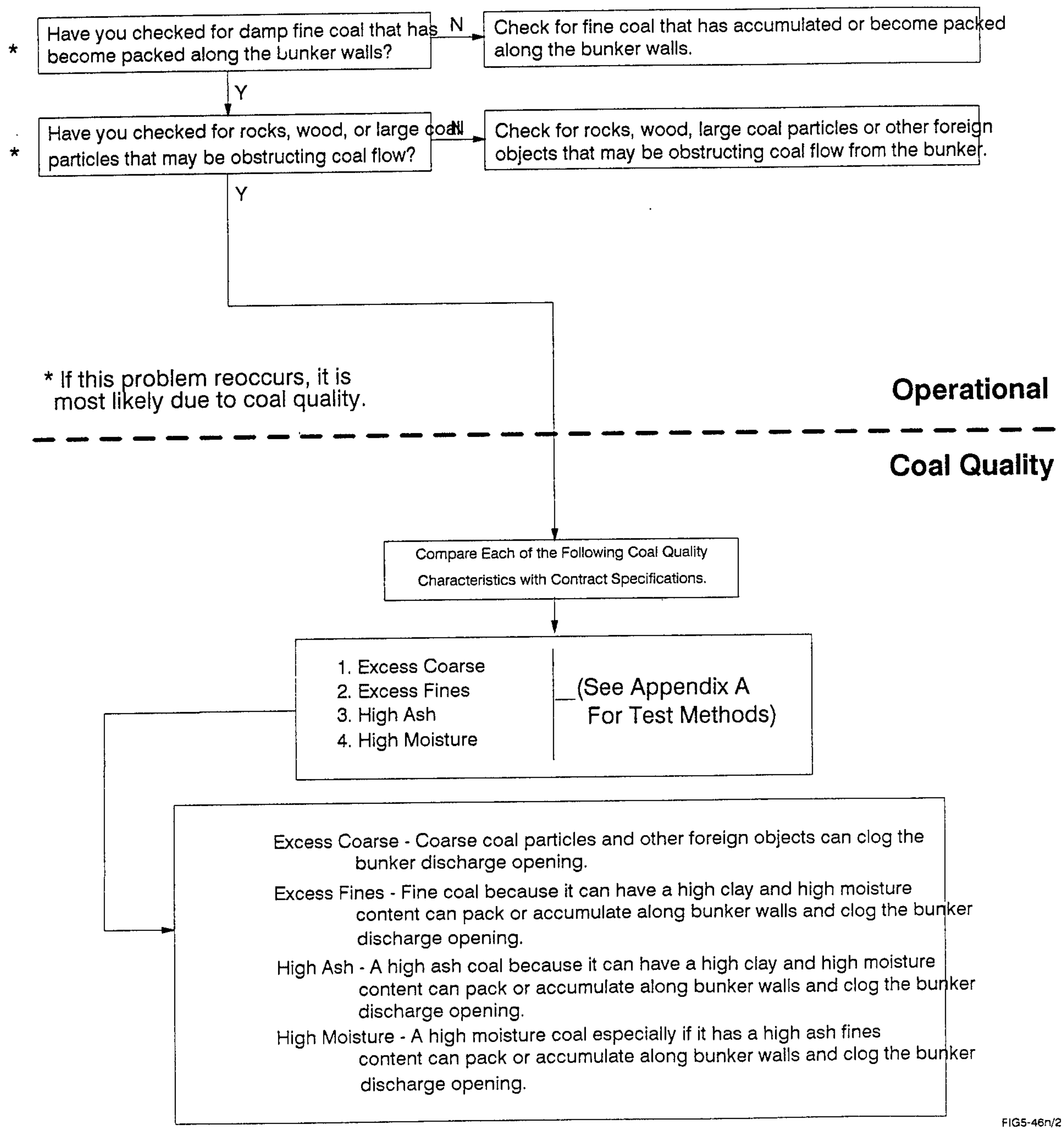


FIG5-46n/2

FIGURE 5-47: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Hopper

Does the hopper have a cut-off gate? — Y → Check to see that the gate is completely opened and secured.

↓ N

* Have you checked for large rocks, wood, pieces of coal, that are preventing coal flow onto the grate? — N → Check for and remove large rocks, wood, pieces of coal that are preventing coal flow onto the grate.

↓ Y

Have you checked for pluggage in the coal feeder? — N → Check for pluggage in the coal feeder. NOTE: See Operational Section of Figure 5-41.

↓ Y

Have you checked for pluggage in the coal bunker? — N → Check for pluggage in the coal bunker. NOTE: See Operational Section of Figure 5-44.

↓ Y

Have you checked for pluggage in you coal feed conveyor? — N → Check for pluggage in the coal feed conveyor. NOTE: See figure 5-5 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.

↓ Y

Have you checked your automatic coal reclaim for pluggage? — N → Check your automatic coal reclaim for pluggage. NOTE: See figure 5-5 to identify the type of coal feed conveyor you have and follow the Operational Section of the corresponding logic diagram for pluggage.

↓ Y

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

↓

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

↓

Excess Coarse - Coarse coal particles and other foreign objects can clog the hopper discharge opening.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the hopper discharge opening.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the hopper discharge opening.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the hopper discharge opening.

FIG5-47n/2

FIGURE 5-48: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

Insufficient Capacity In The Coal Hopper

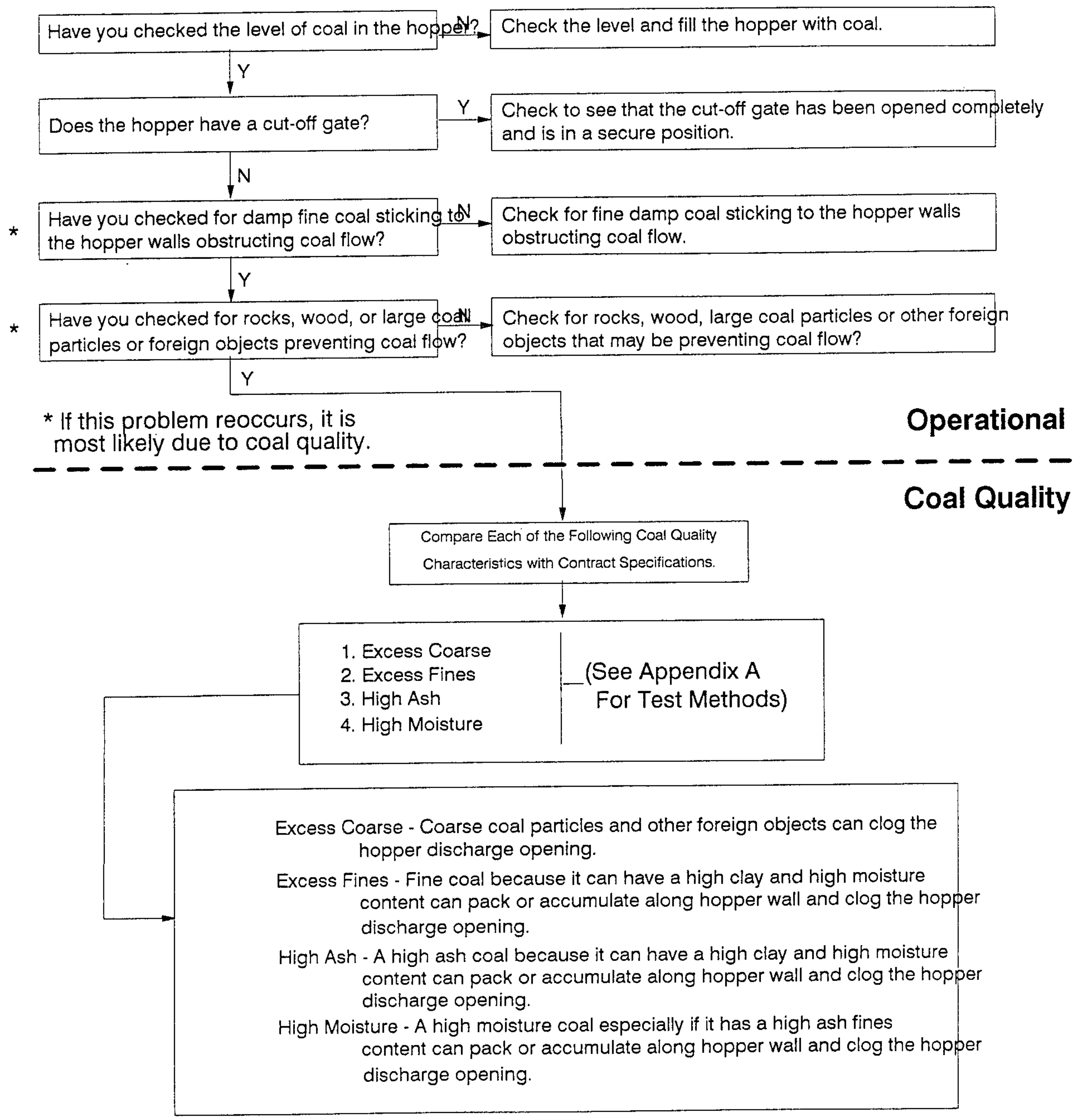


FIG5-48n/2

FIGURE 5-49: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erratic Feeding From The Coal Hopper

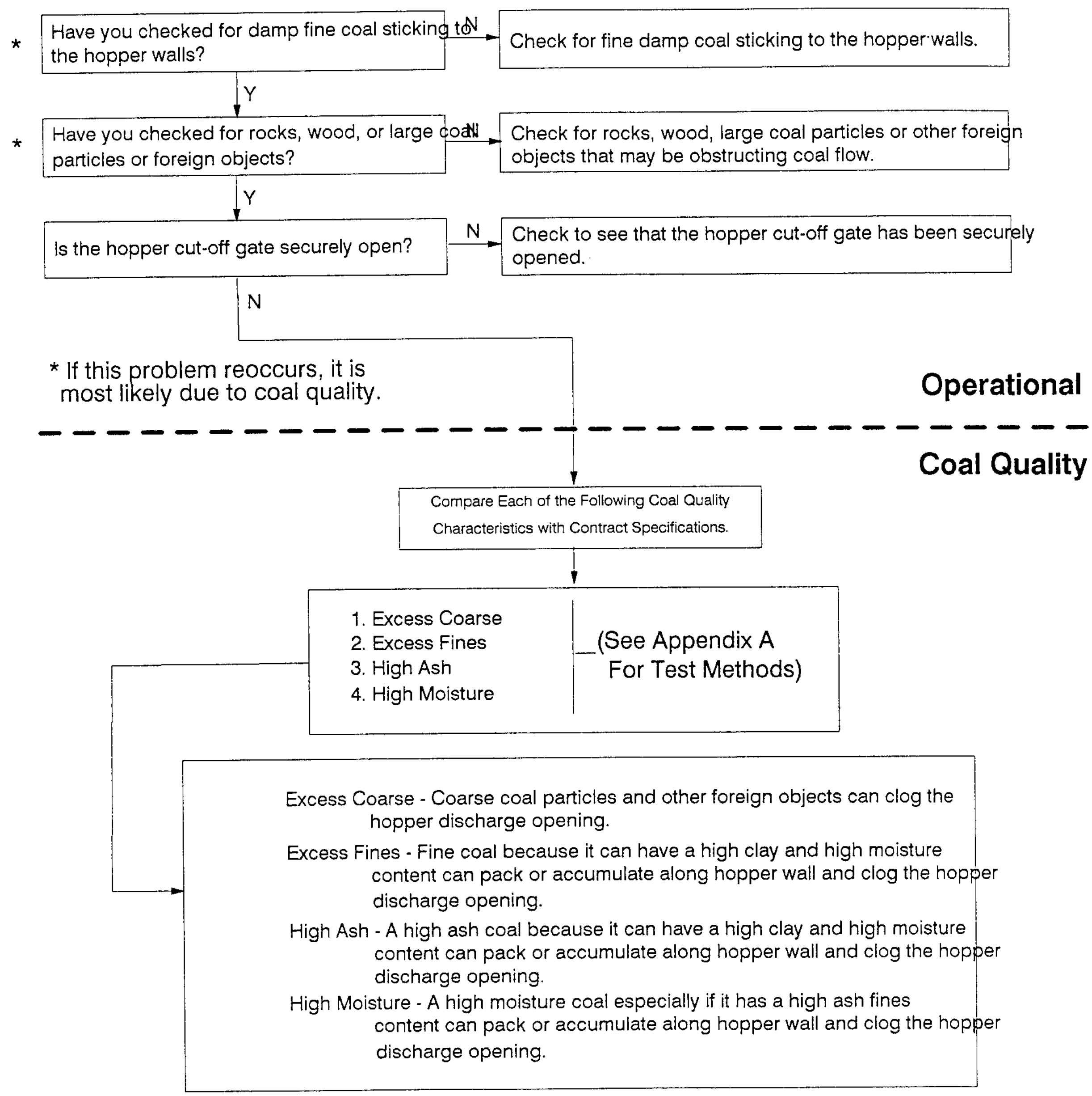


FIG5-49n/2

FIGURE 5-50: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Pulverizing

(Pulverizer)

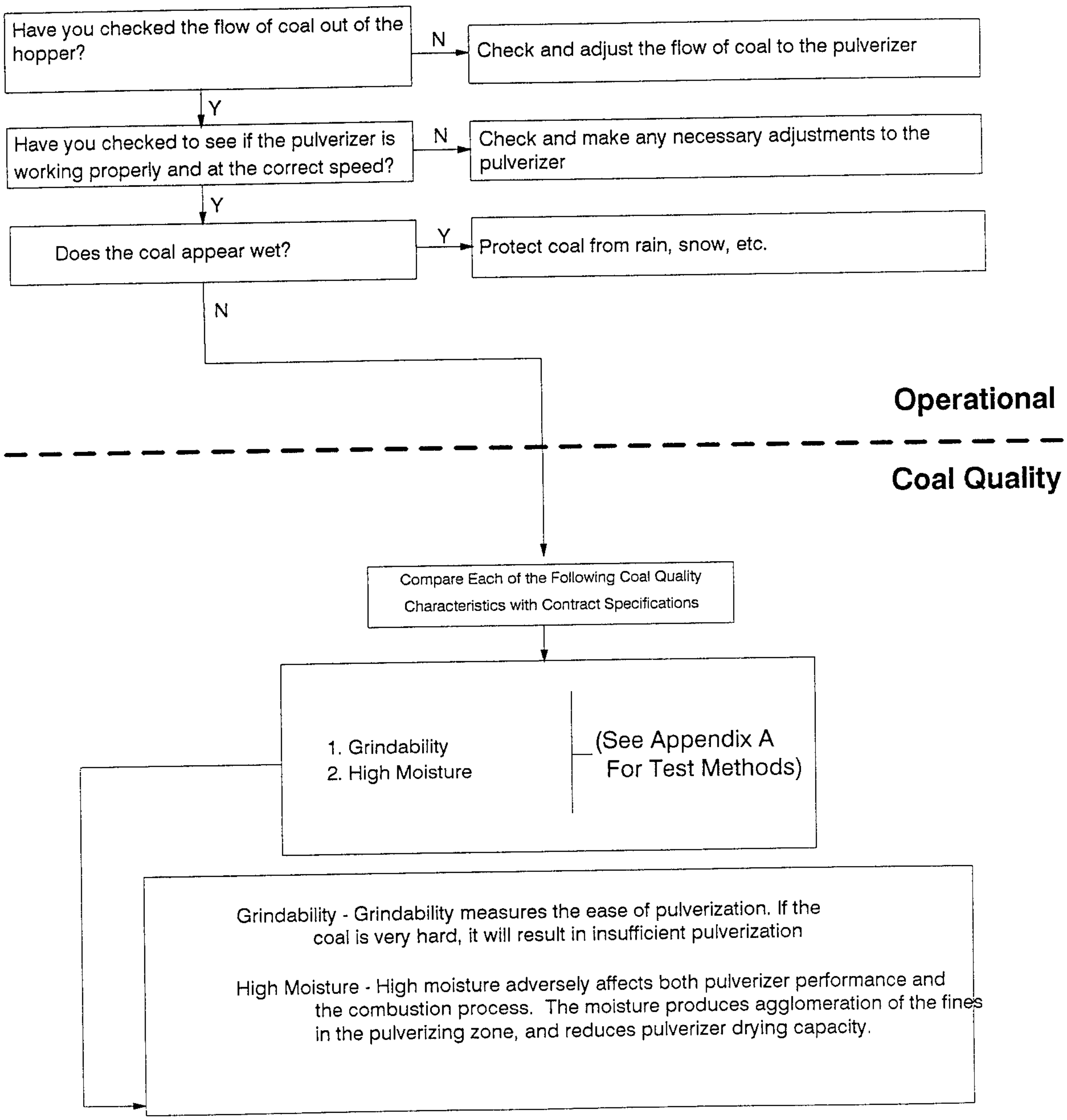


FIG5-50n/2

FIGURE 5-51: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Excessive Pulverizing

(Pulverizer)

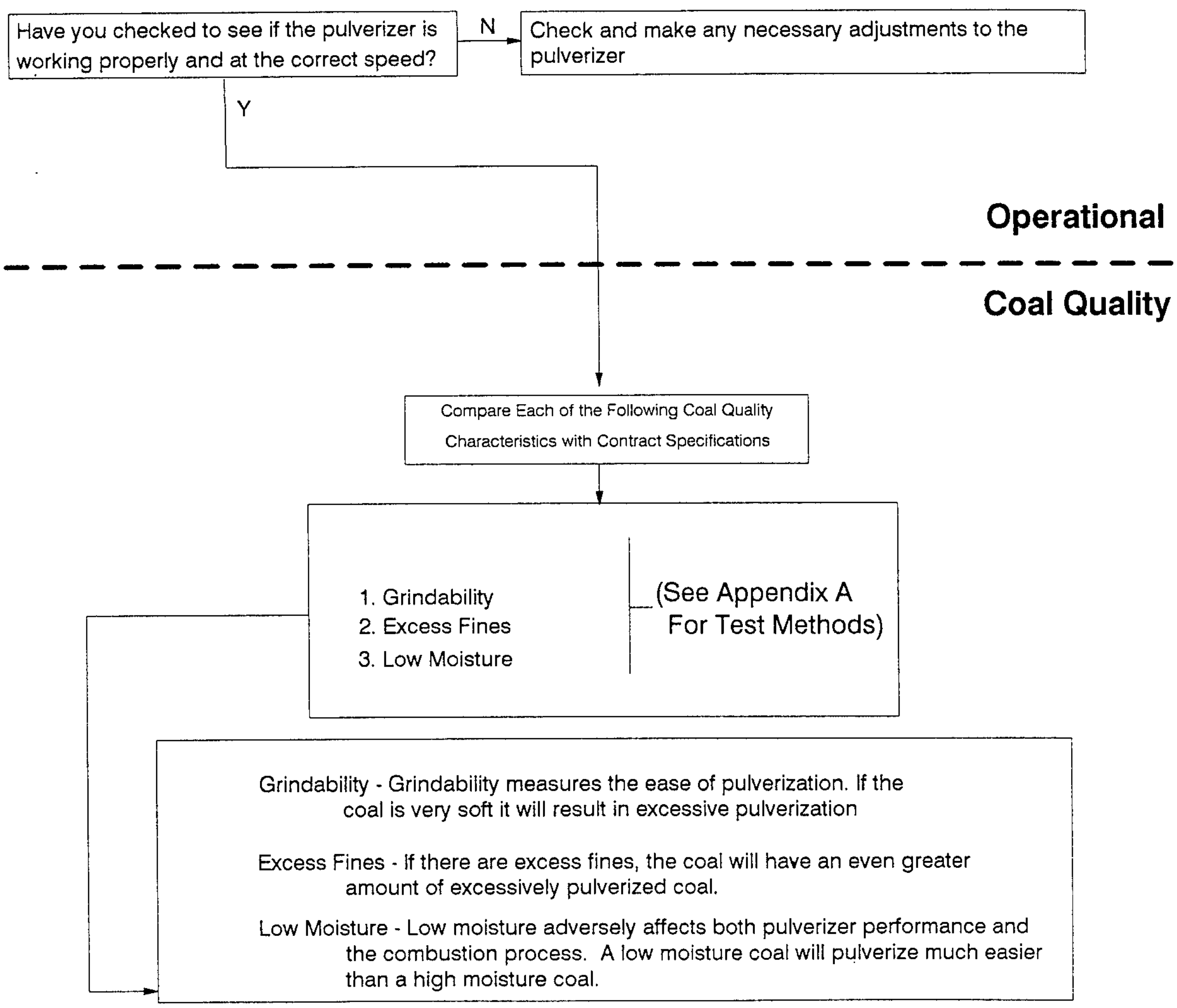


FIG5-51n/2

FIGURE 5-52: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Drying
(Pulverizer)

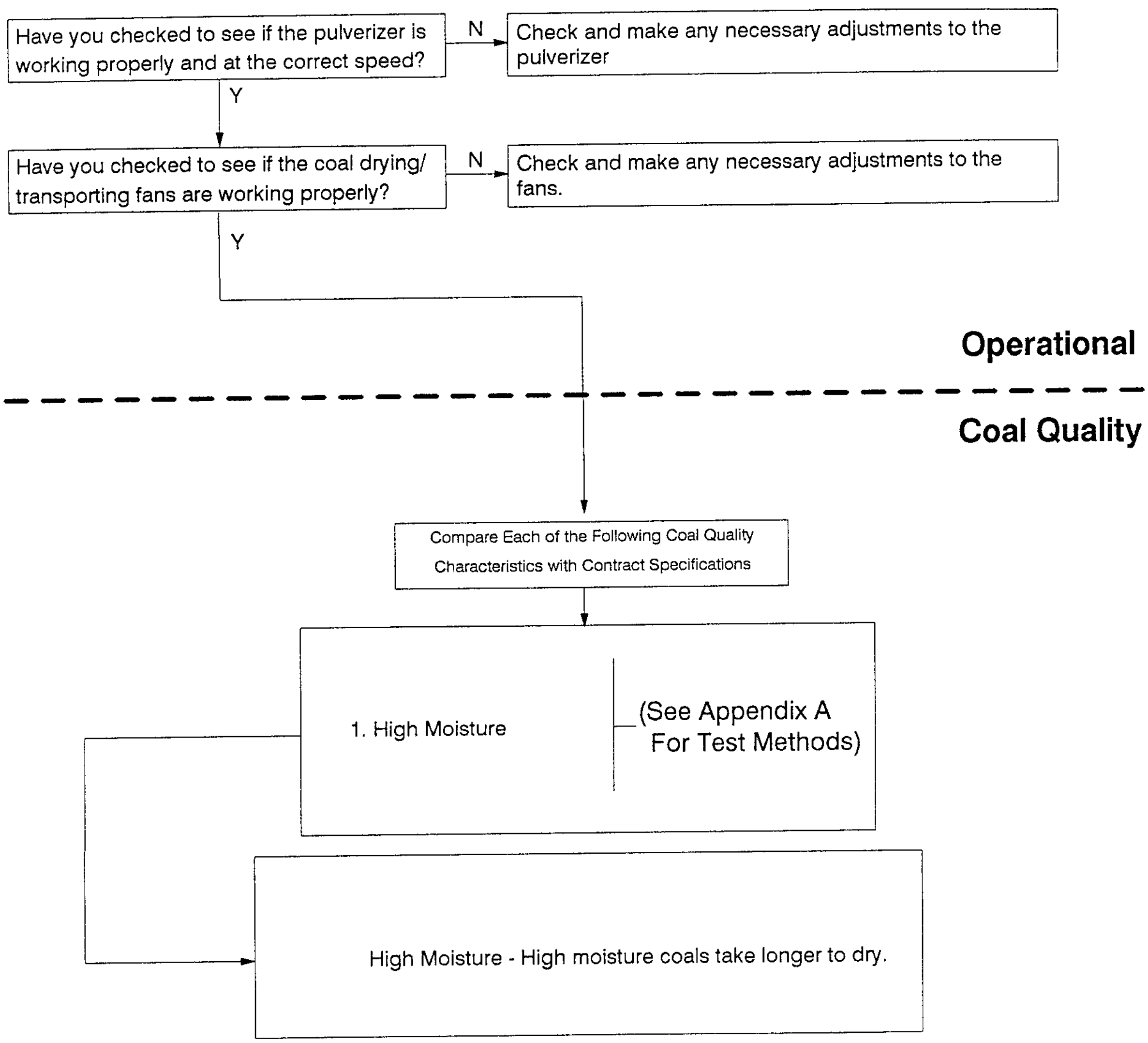


FIG5-52n/2

FIGURE 5-53: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load

(Boiler)

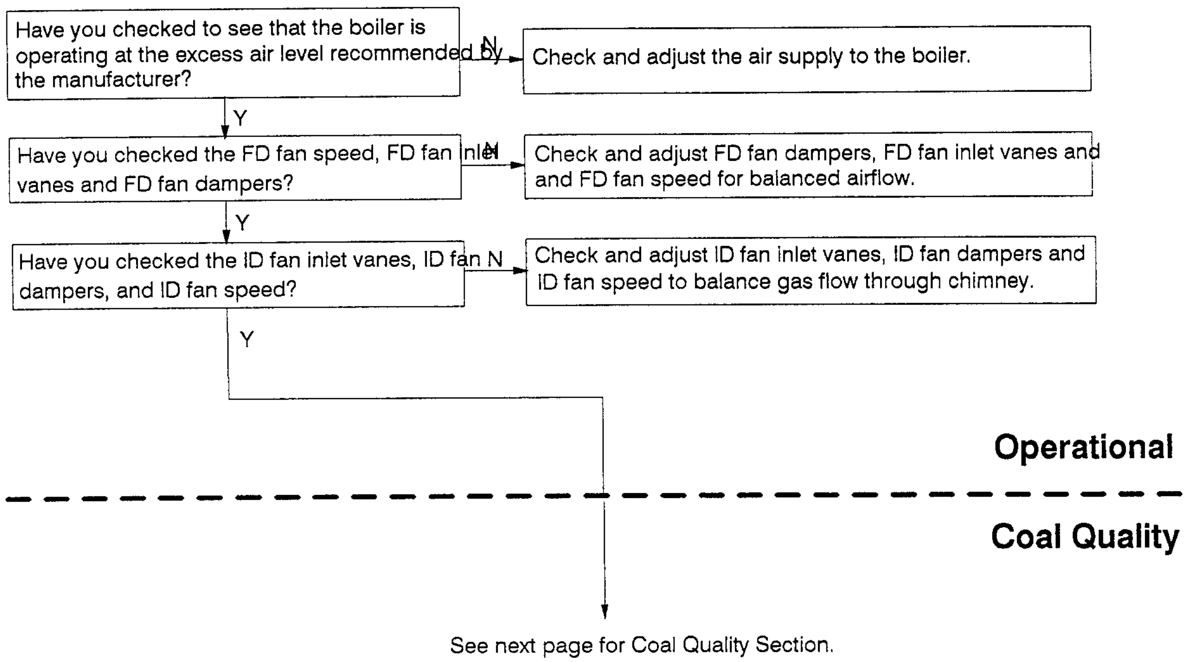


FIG5-53n/2

FIGURE 5-53 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. Excess Fine
5. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

Excess Fines - Too many fines can cake (agglomerate) making it difficult to complete combustion.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG5-53nb/2

FIGURE 5-54: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Reduced Boiler Efficiency

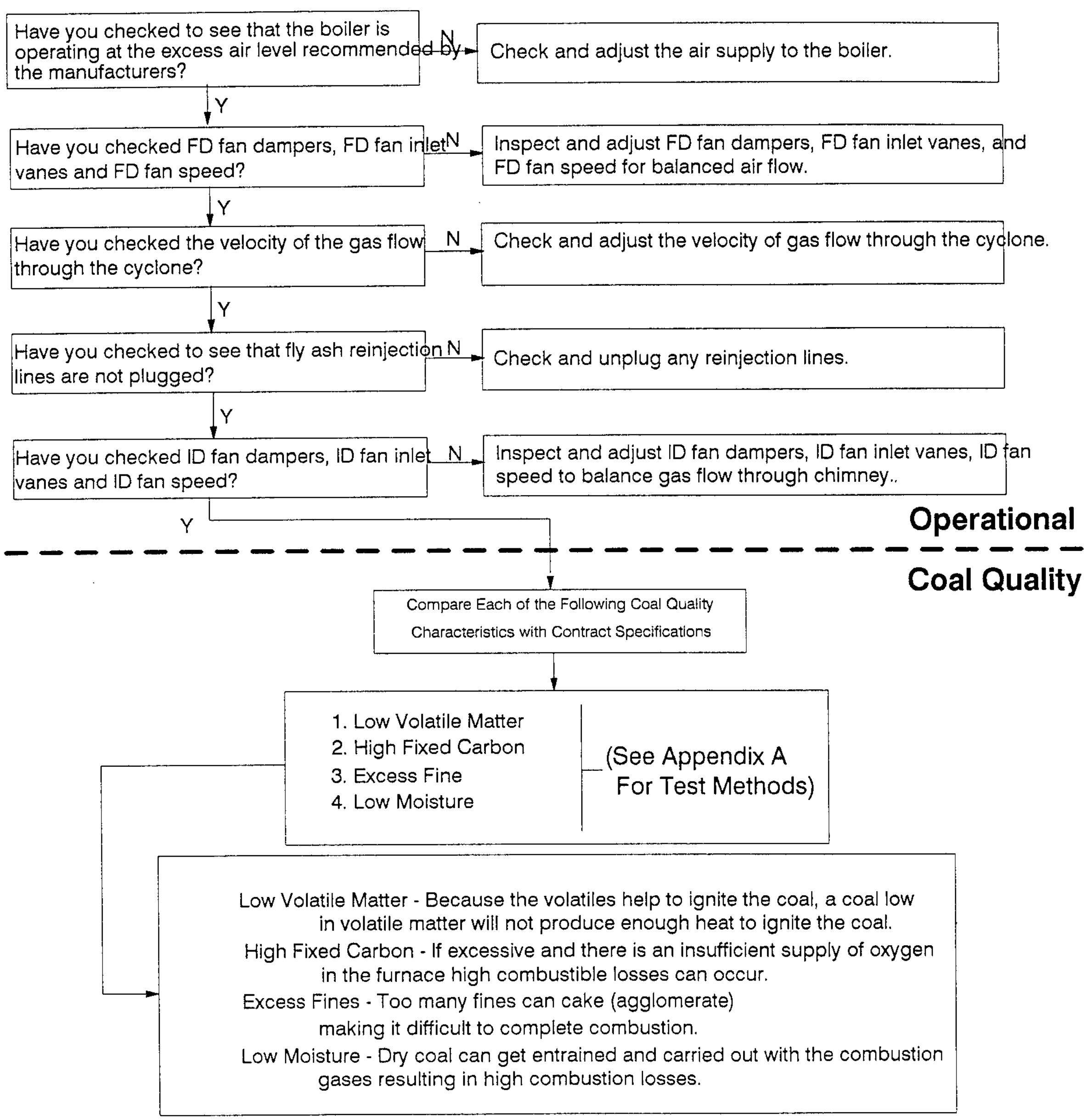


FIG5-54n/2

FIGURE 5-55: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Burners

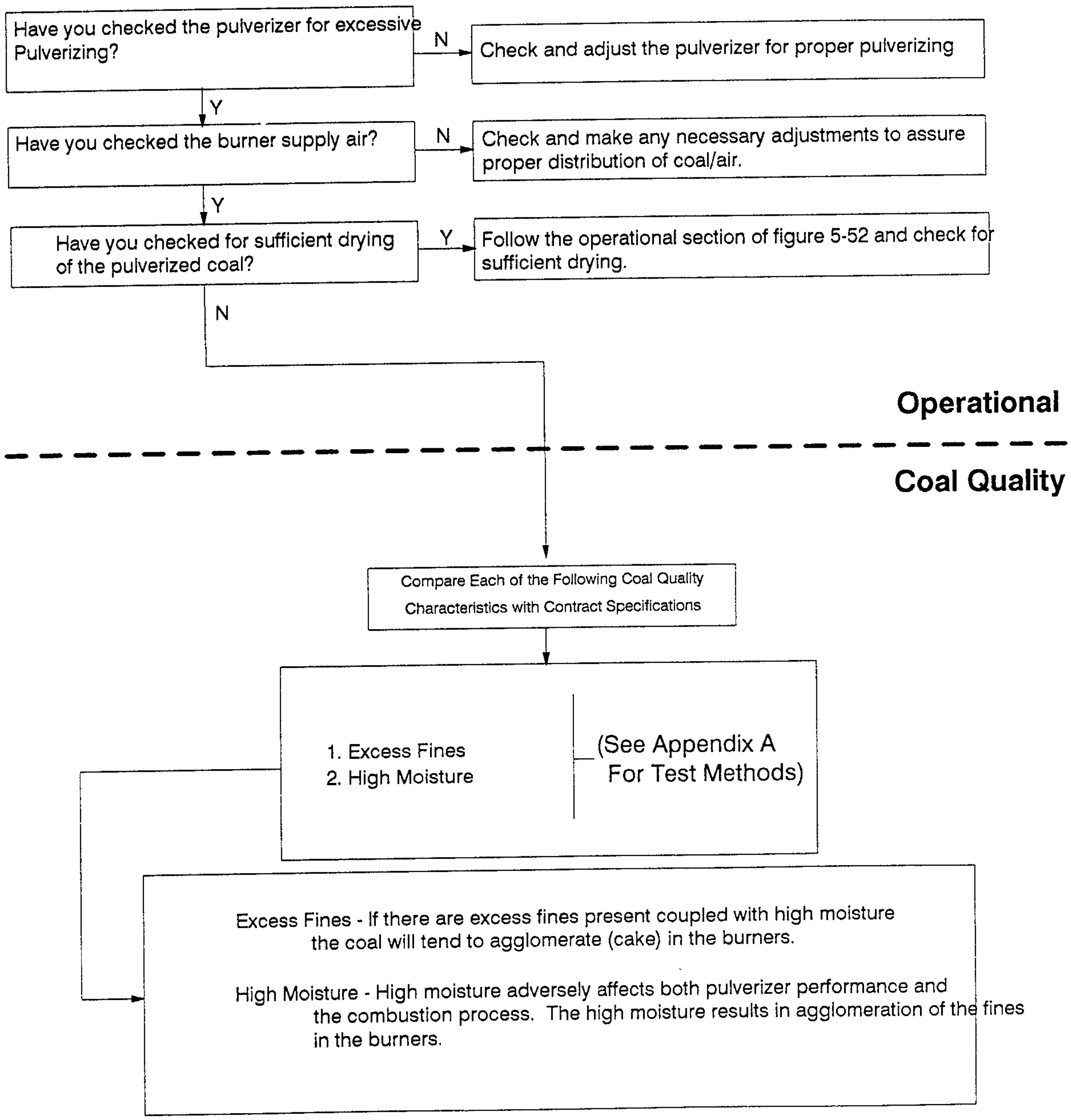


FIG5-55n/2

FIGURE 5-56: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Burners

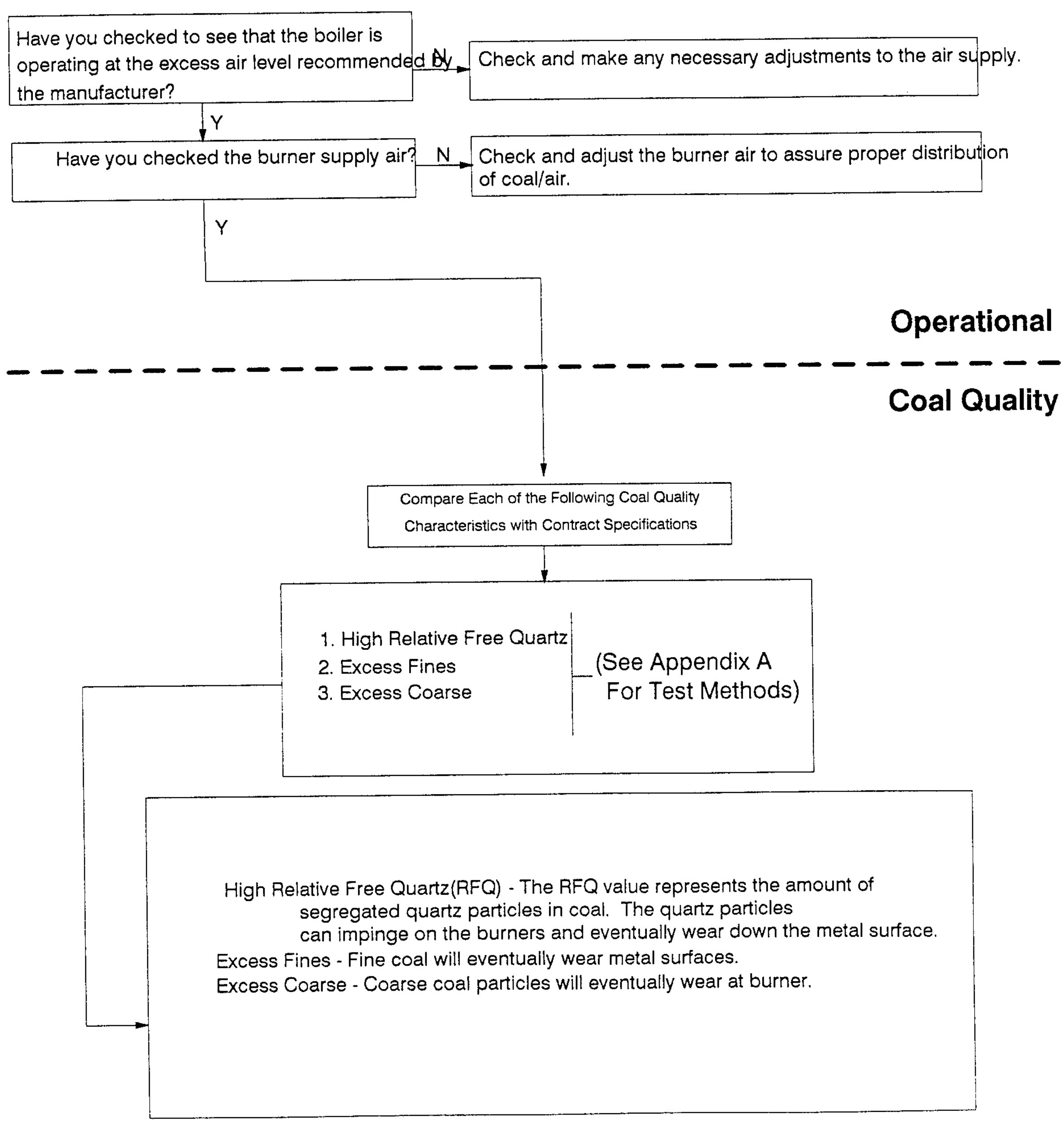


FIG5-56n/2

FIGURE 5-57: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

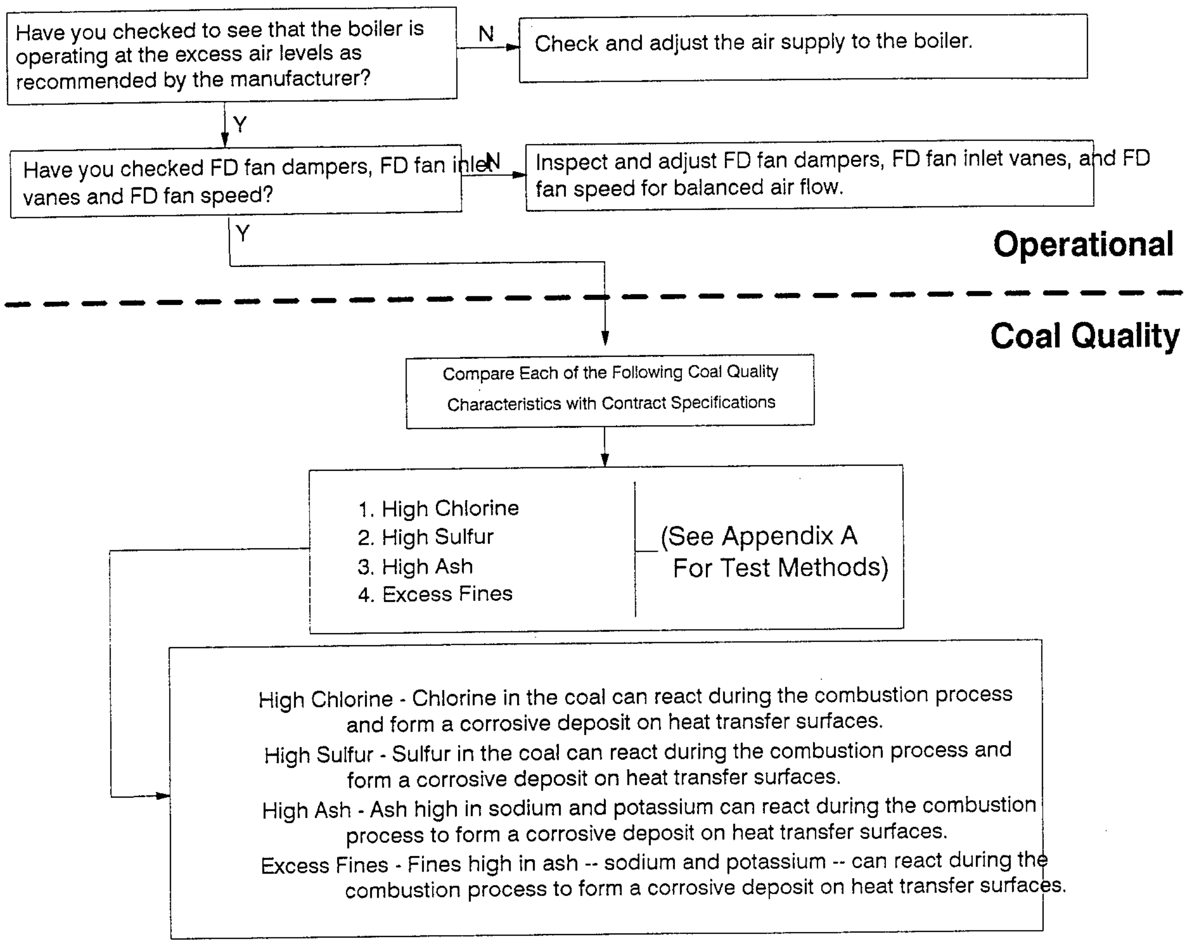
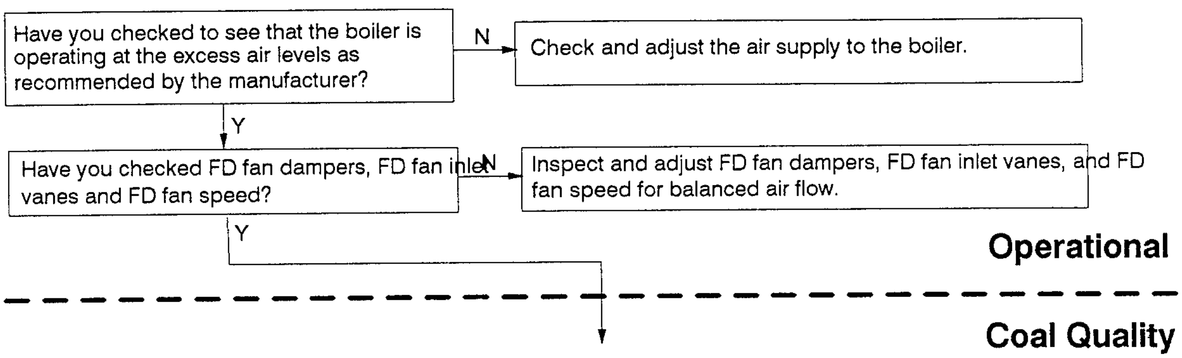


FIG5-57n/2

FIGURE 5-58: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Heat Transfer Surfaces

(Boiler Tubes and Water Walls)



See next page for Coal Quality Section

FIG5-58n/2

FIGURE 5-58 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on heat transfer surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with heat transfer surfaces eventually wearing away the surface.

FIG5-58nb/2

FIGURE 5-59: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Boiler Tubes and Water Walls)

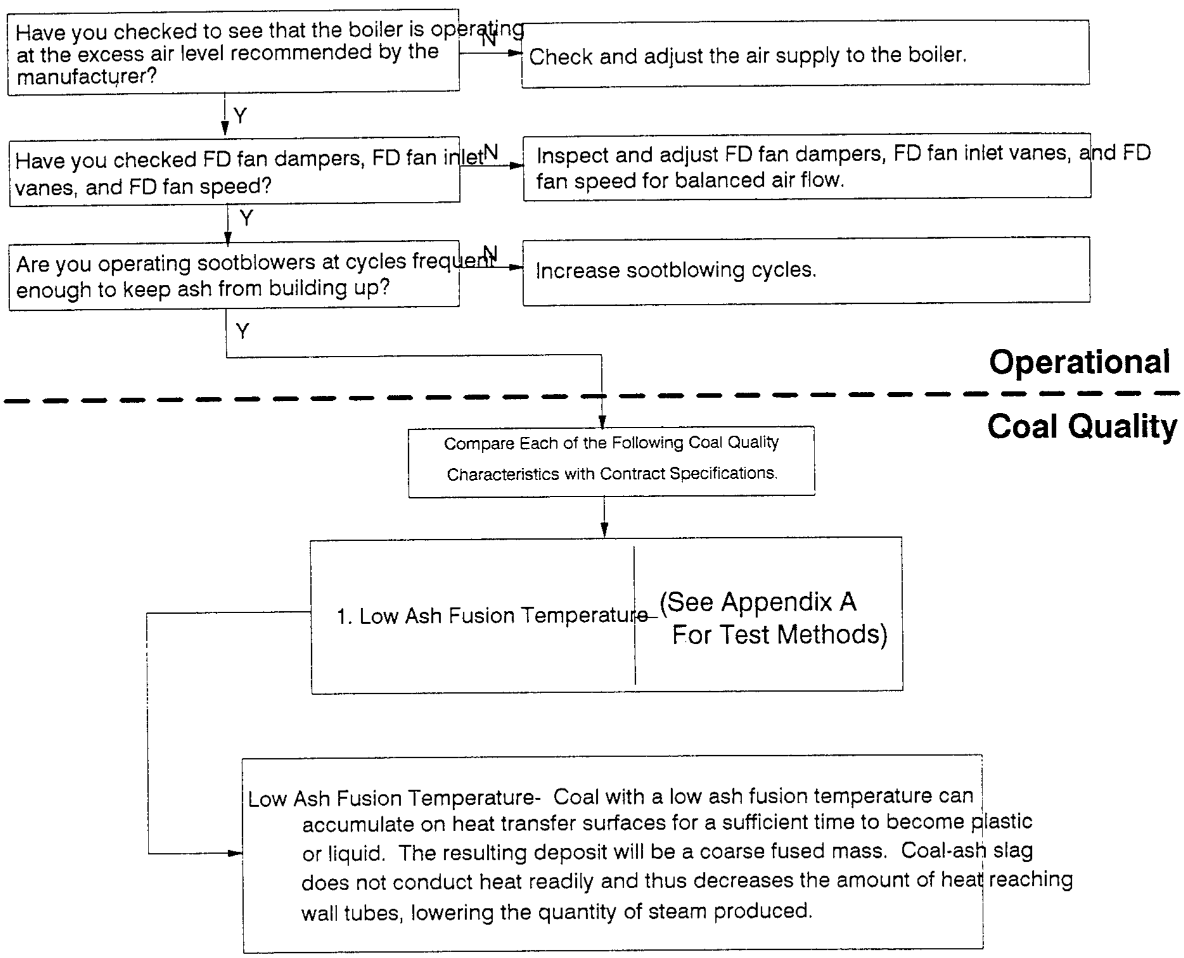


FIG5-59N/2

FIGURE 5-60: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

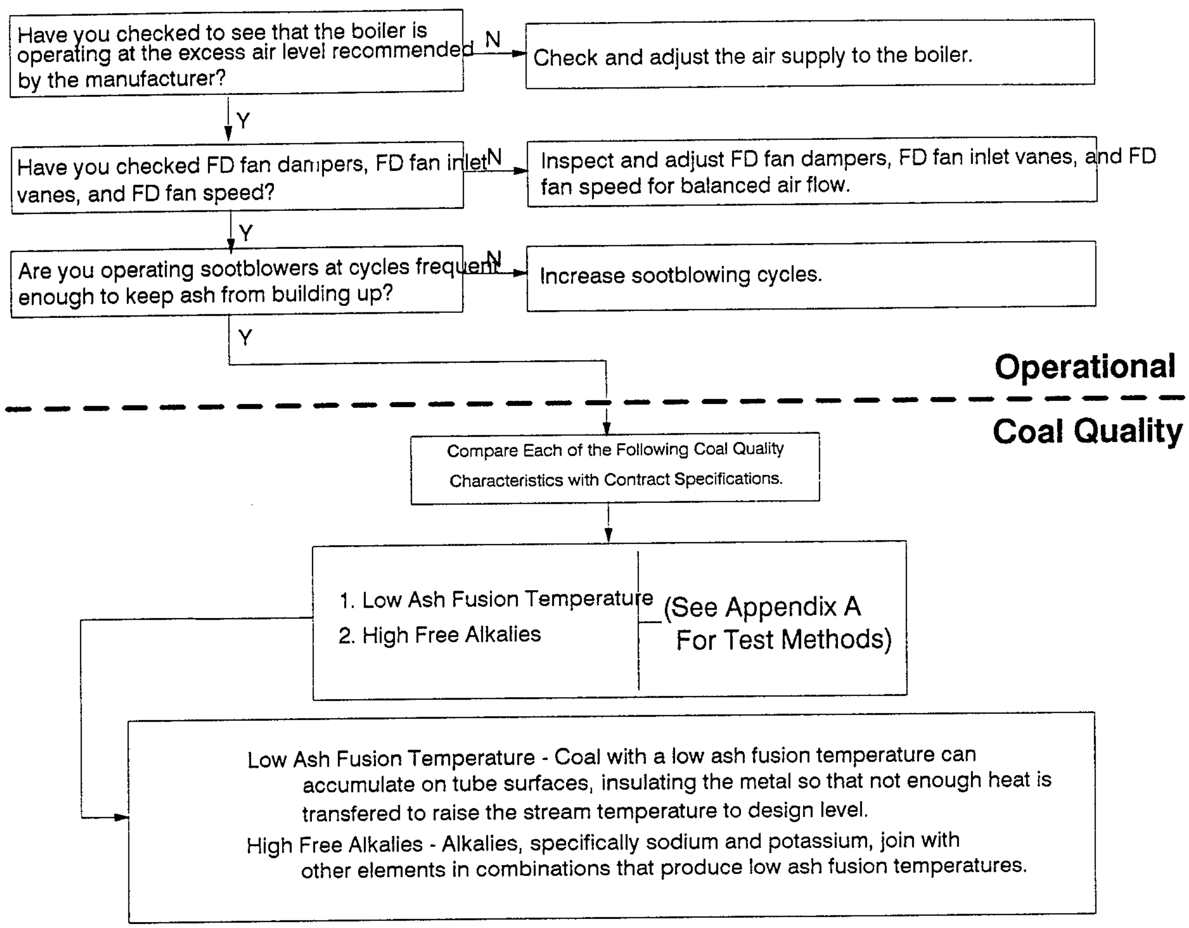


FIG5-60N/2

FIGURE 5-61: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load

(Forced Draft Fan)

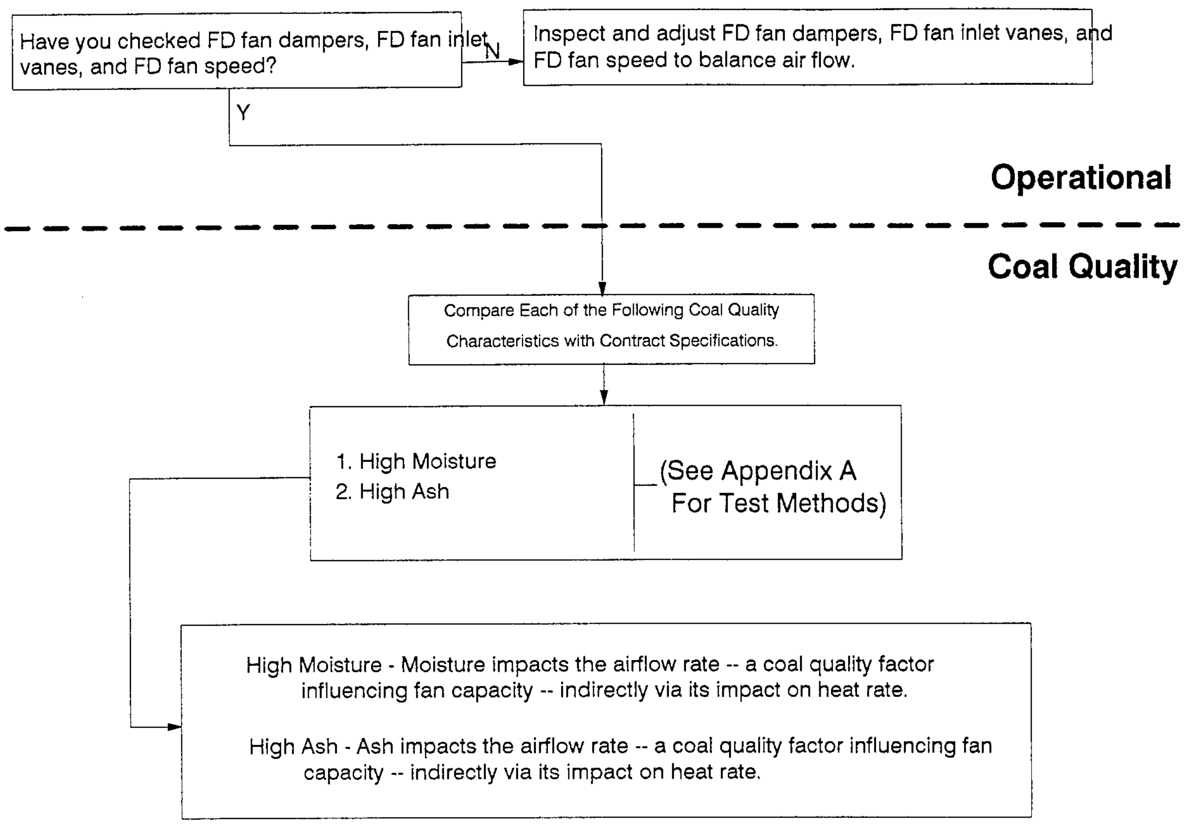


FIG5-61n/2

FIGURE 5-62: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Forced Draft Fan

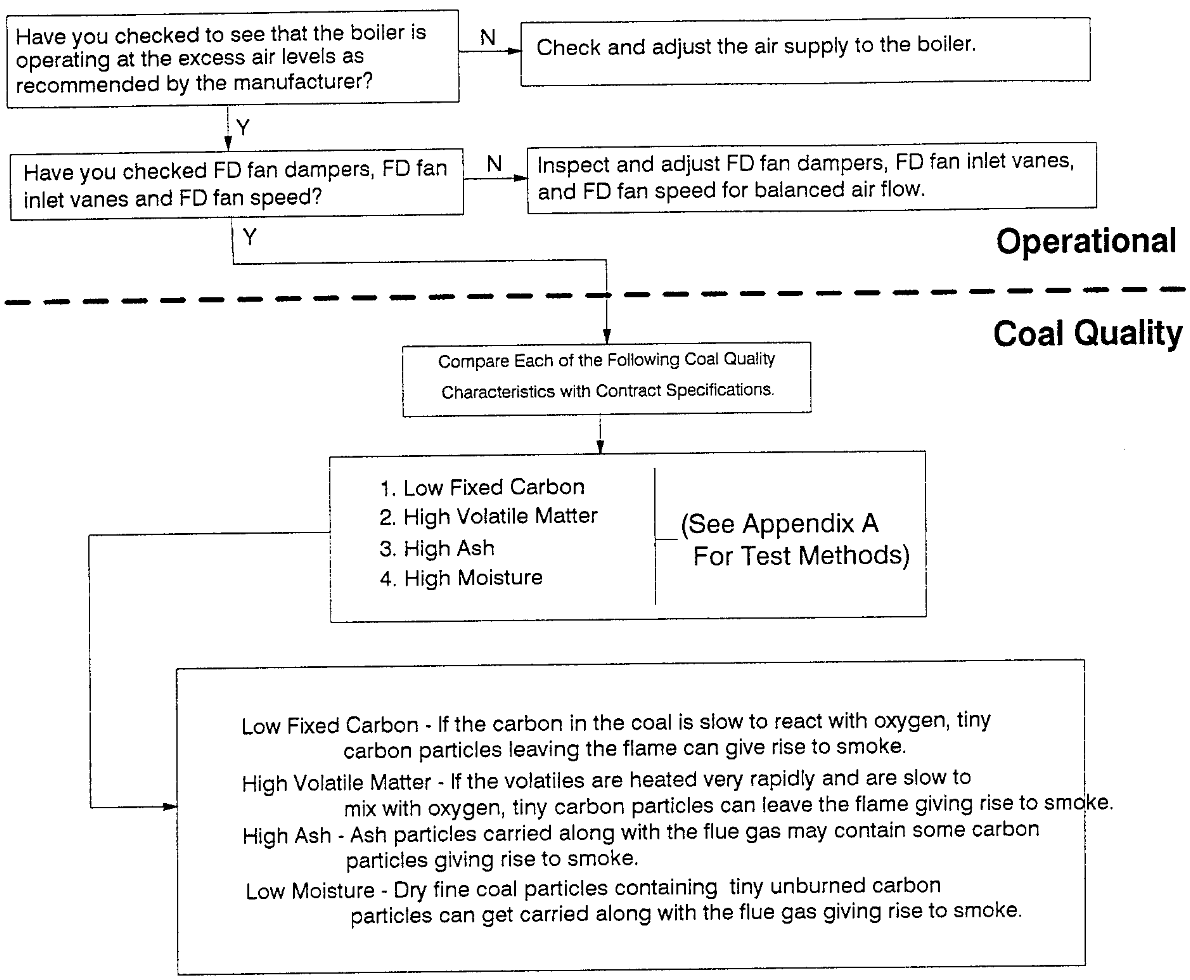


FIG5-62n/2

FIGURE 5-63: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Induced Draft Fan)

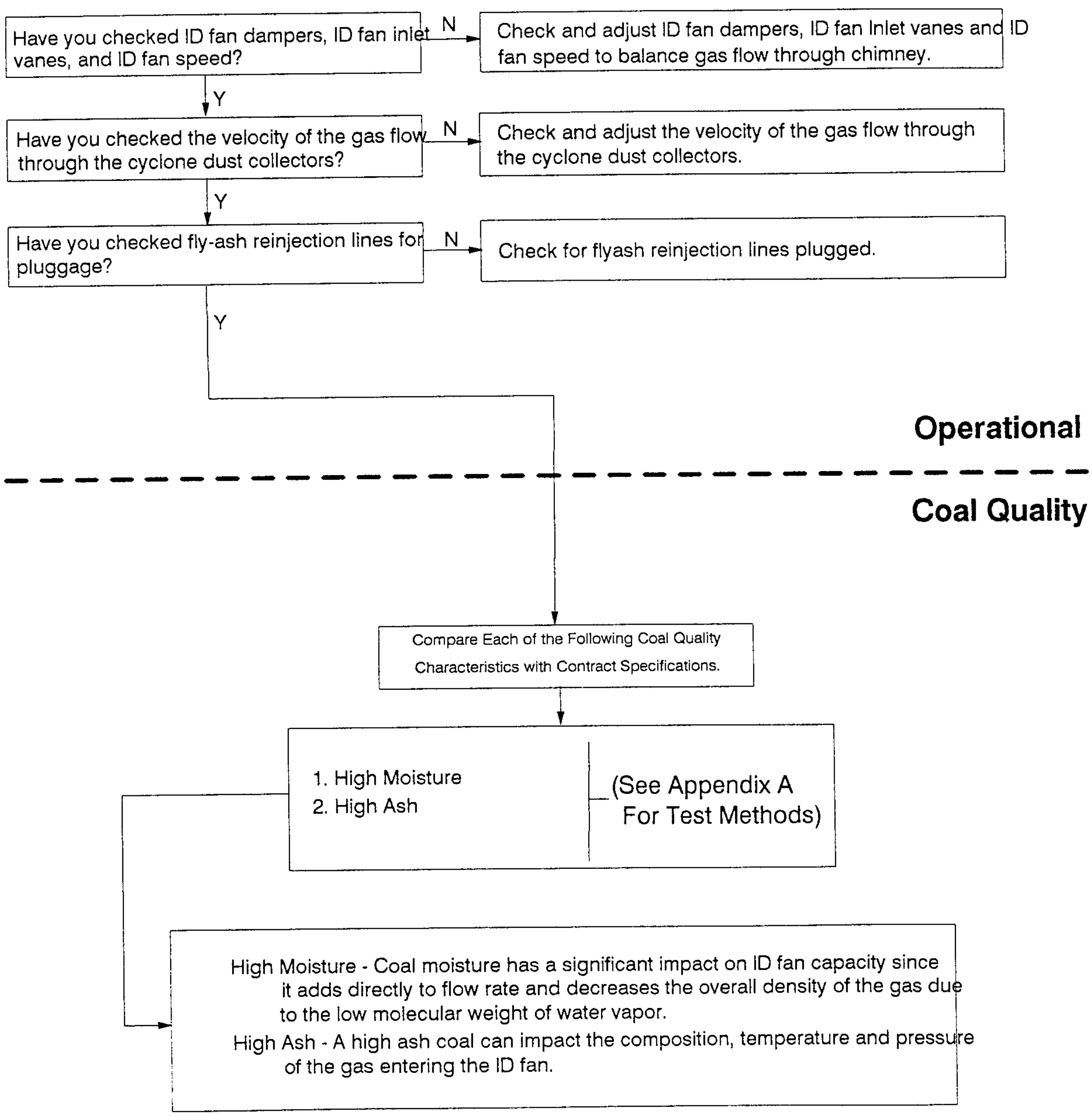


FIG5-63n/2

FIGURE 5-64: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Induced Draft Fan

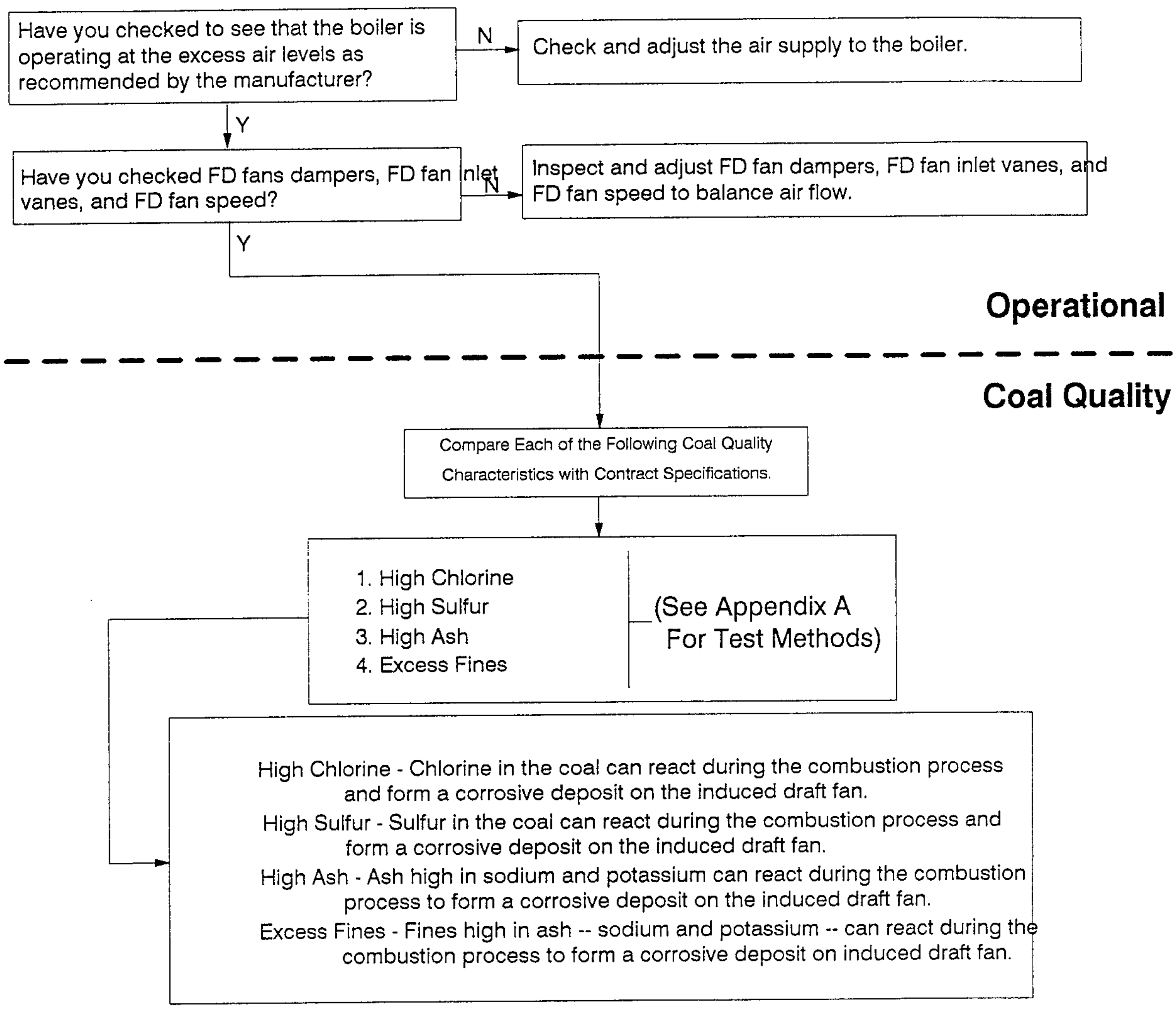
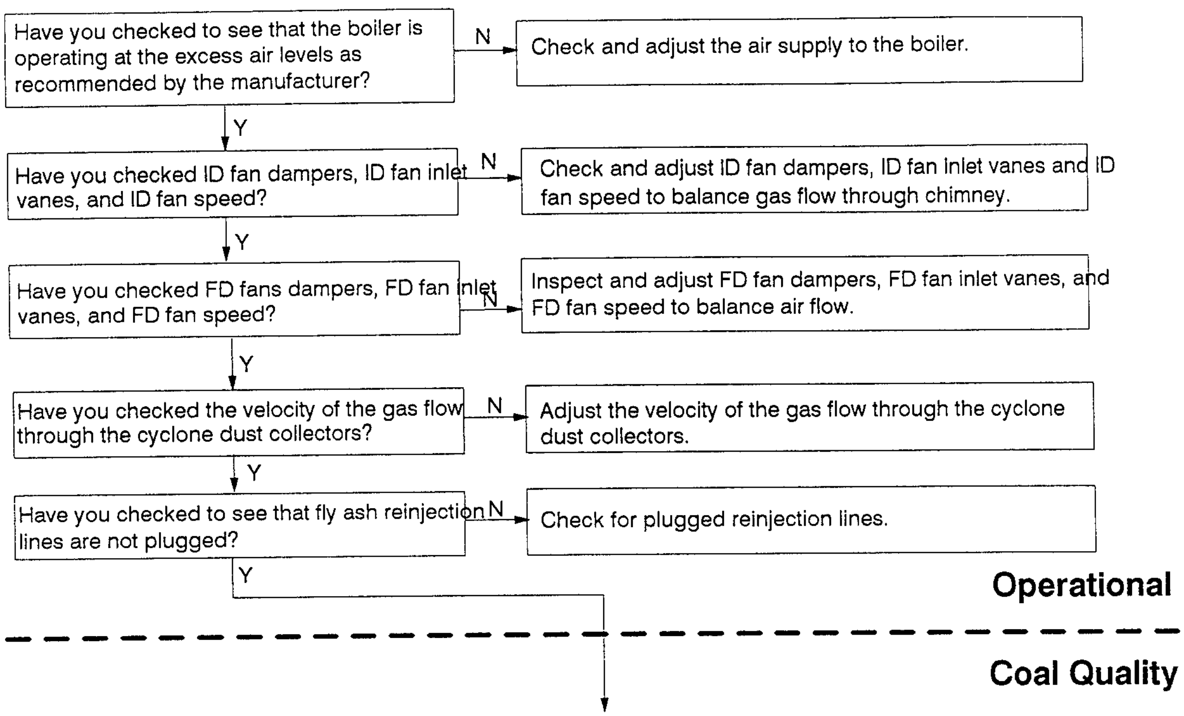


FIG5-64n/2

FIGURE 5-65: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan



See next page the Coal Quality Section.

FIG5-65n/2

FIGURE 5-65 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

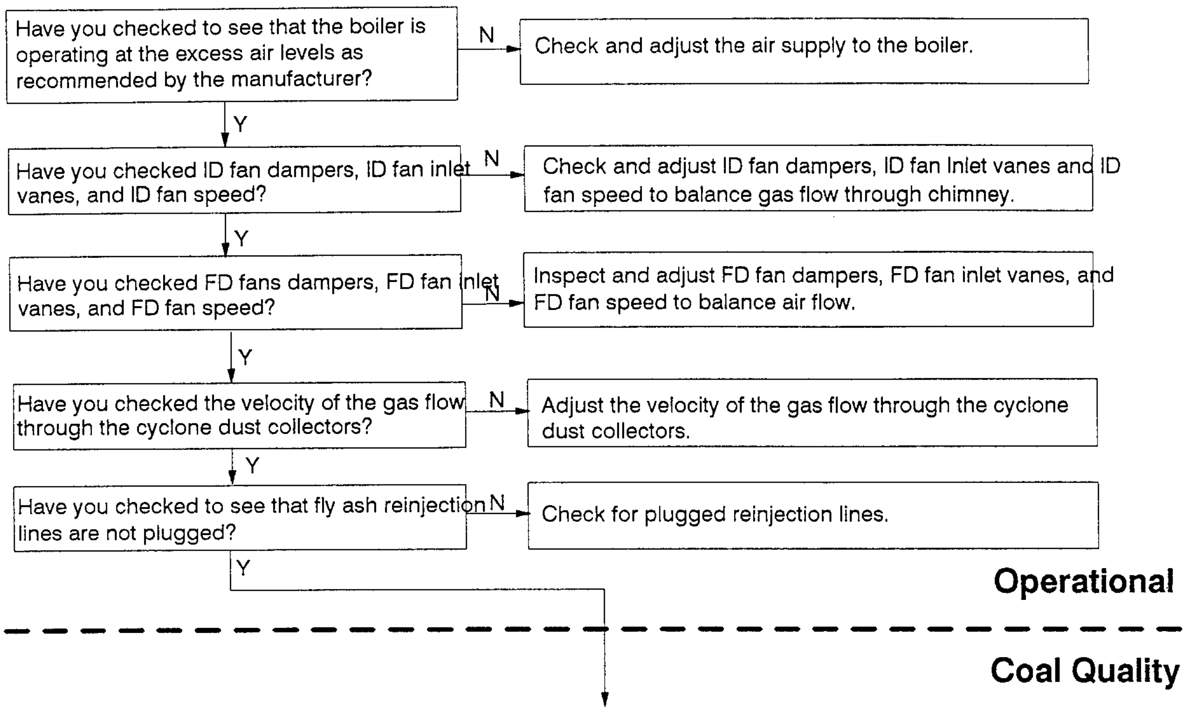
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG5-65nb/2

FIGURE 5-66: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Induced Draft Fan



See next page for the Coal Quality Section.

FIG5-66n/2

FIGURE 5-66 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG5-66nb/2

FIGURE 5-67: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Primary Air Fan)

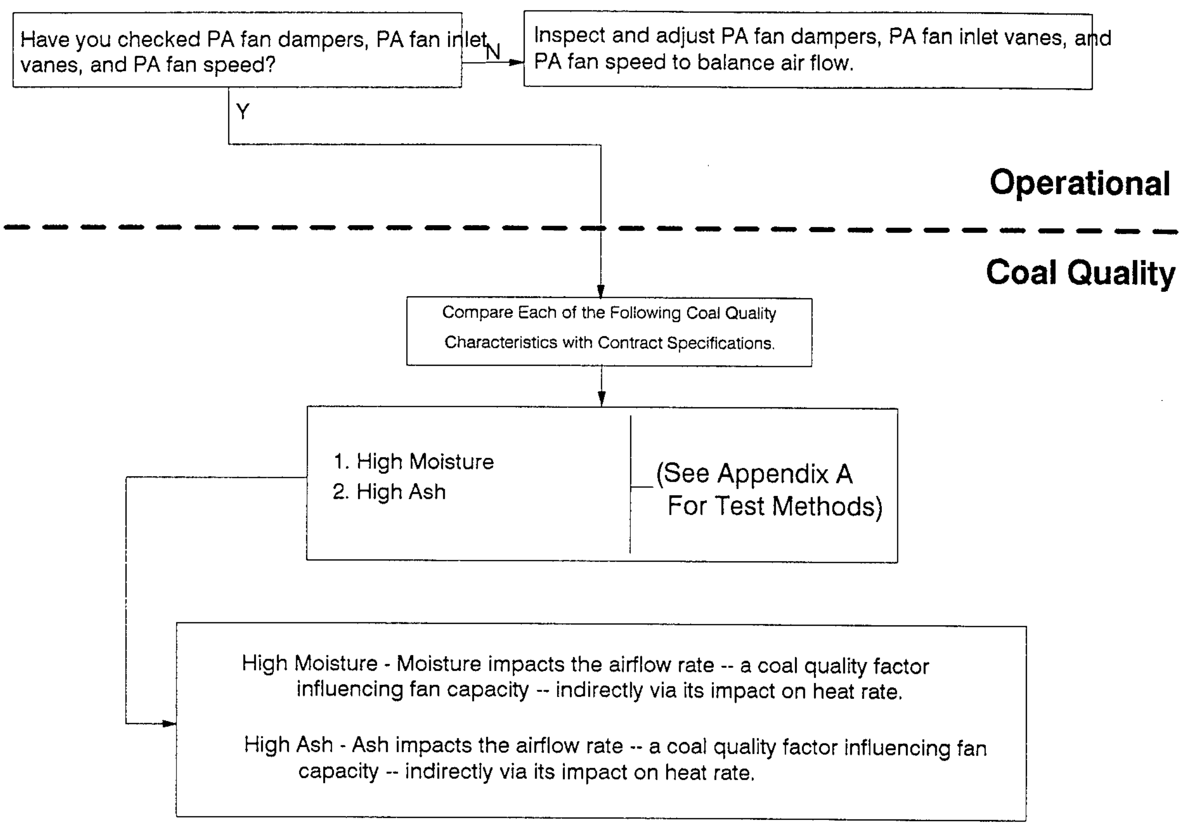


FIG5-67n/2

FIGURE 5-68: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Smoking Around The Primary Air Fan

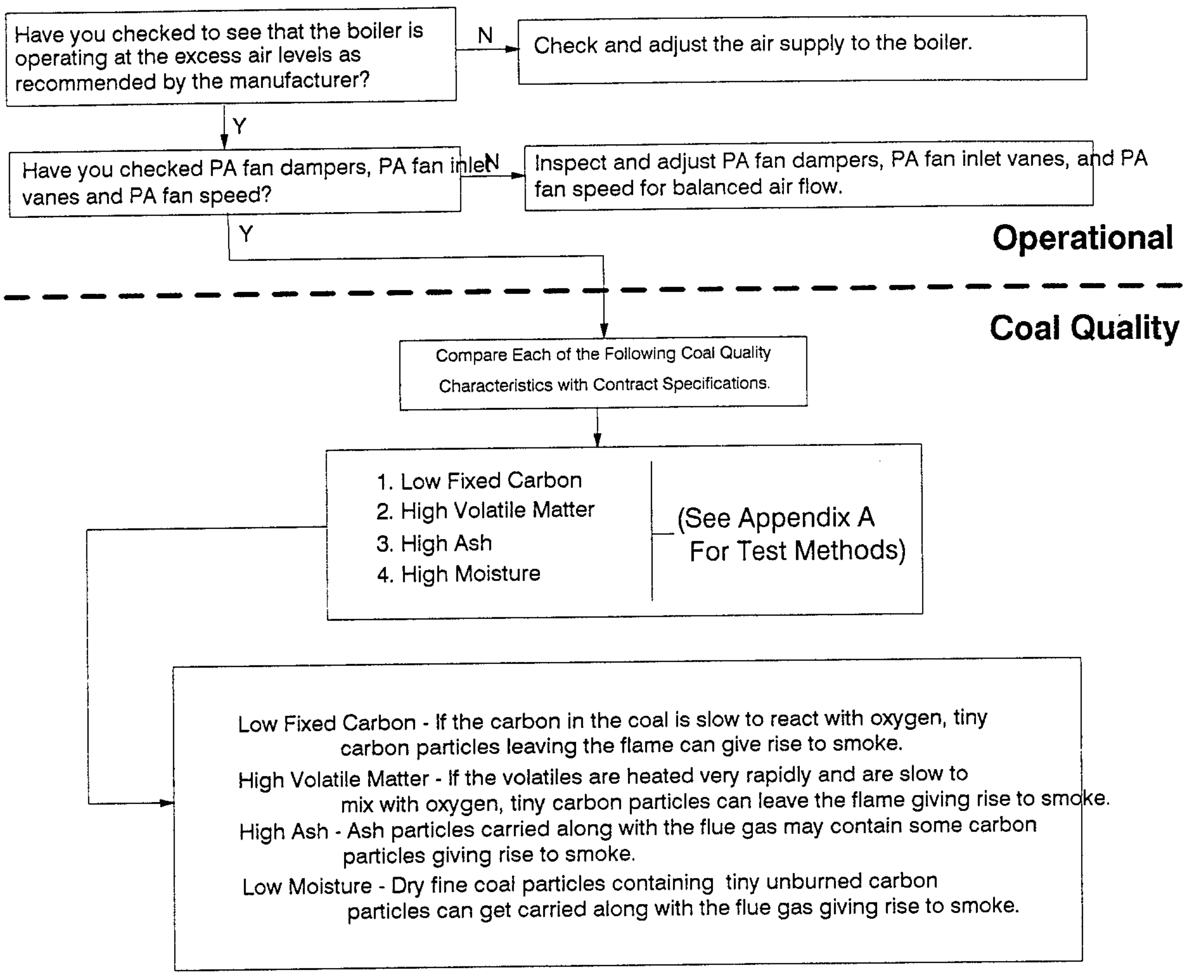
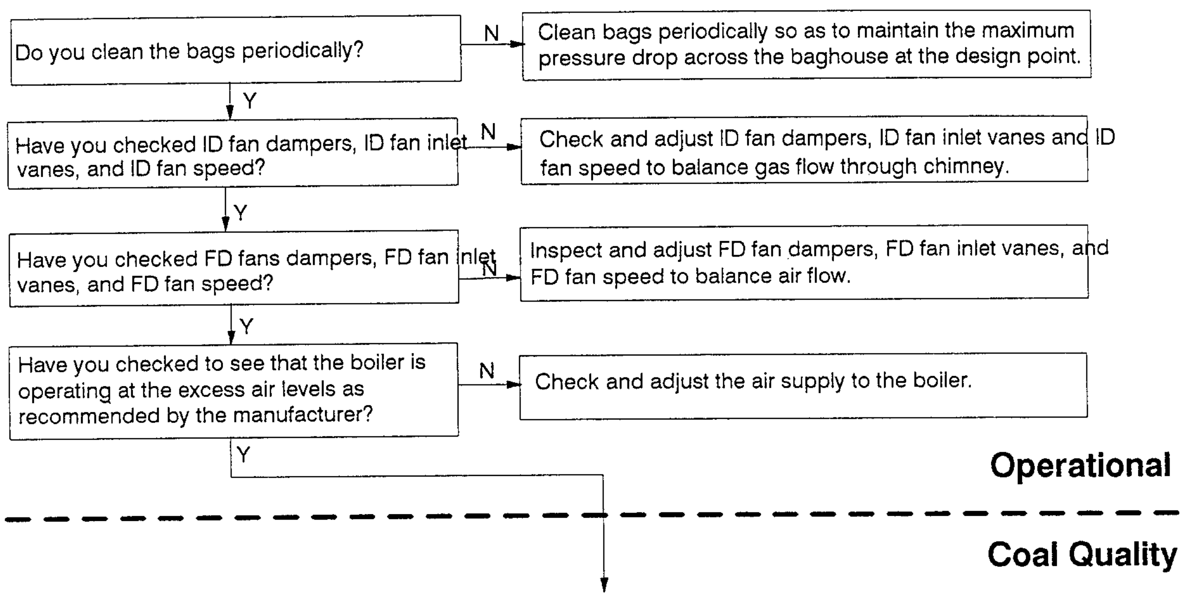


FIG5-68n/2

FIGURE 5-69: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout From The Particulate Removal System (Baghouse)



See next page for the Coal Quality Section.

FIG5-69n/2

FIGURE 5-69 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Baghouse)

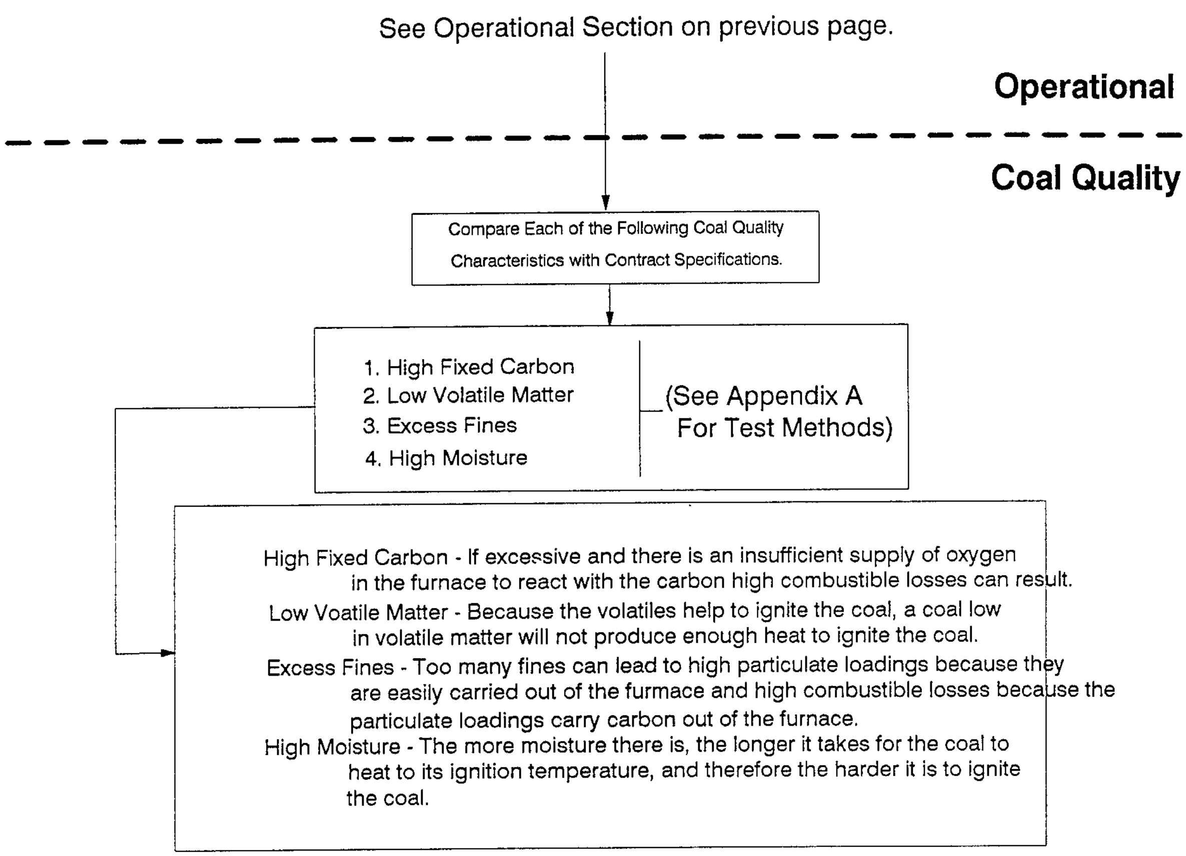


FIG5-69nb/2

FIGURE 5-70: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Baghouse)

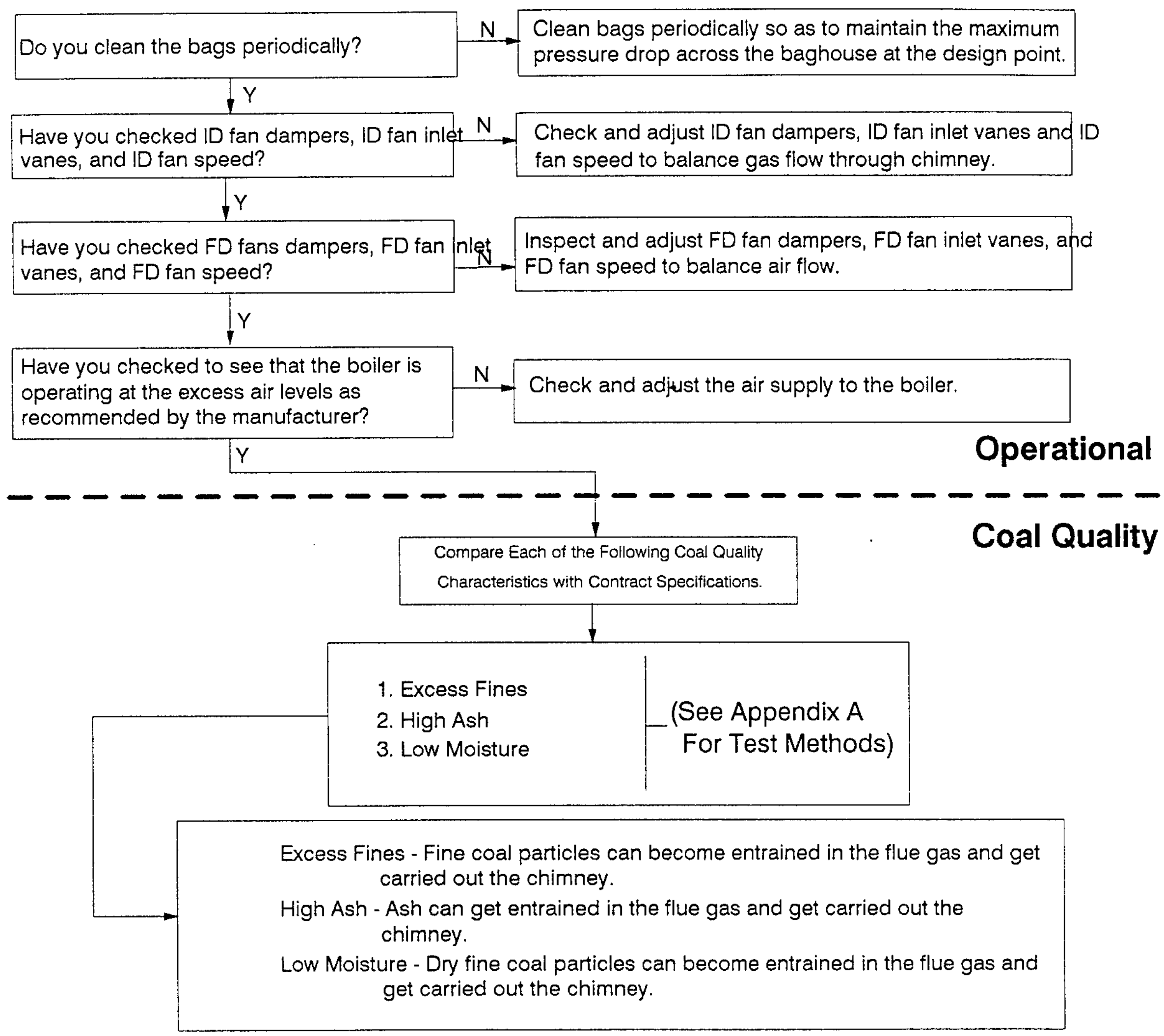
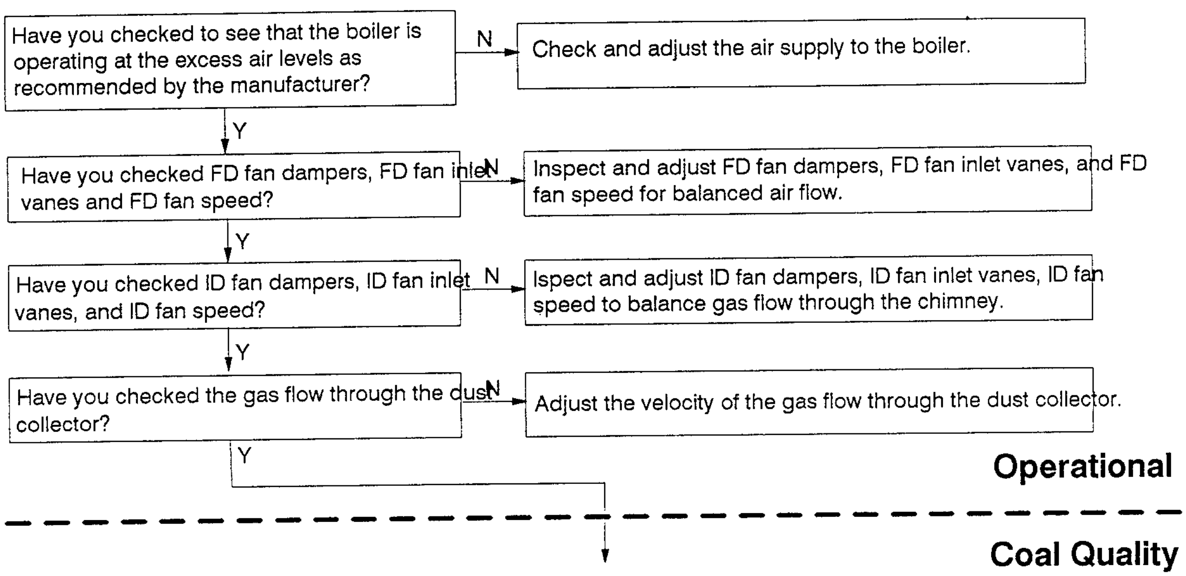


FIG5-70n/2

FIGURE 5-71: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System

(Cyclone)



See next page for Coal Quality Section

FIG5-71n/3

FIGURE 5-71 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

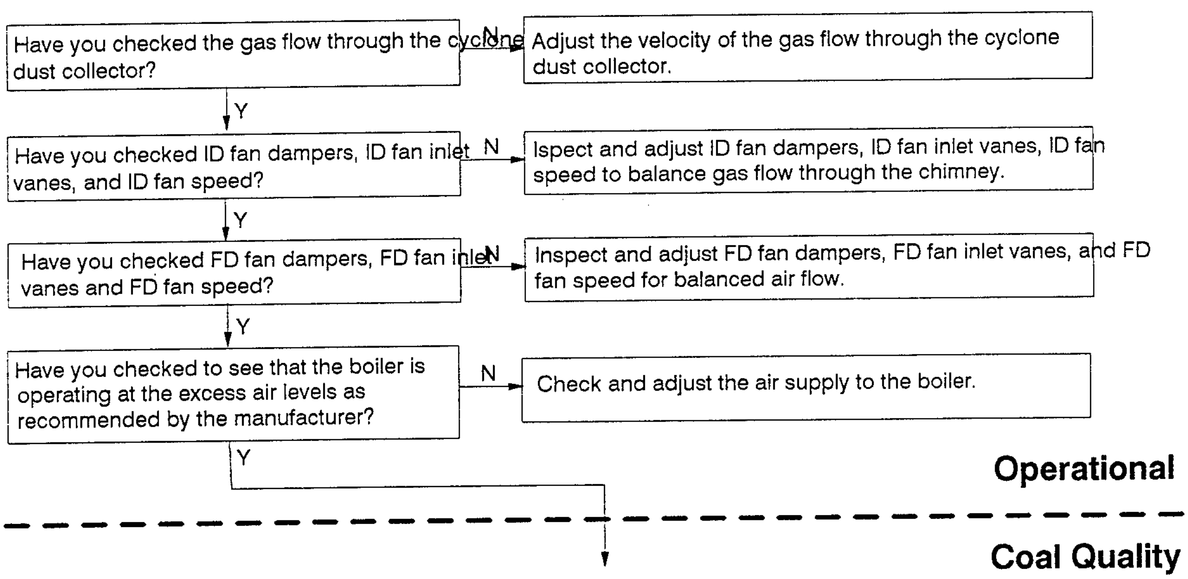
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG5-71nb/3

FIGURE 5-72: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Erosion In The Particulate Removal System
(Cyclone)



See next page for Coal Quality Section

FIG5-72n/3

FIGURE 5-72 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion In The Particulate Removal System (Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG5-72nb/3

FIGURE 5-73: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Cyclone)

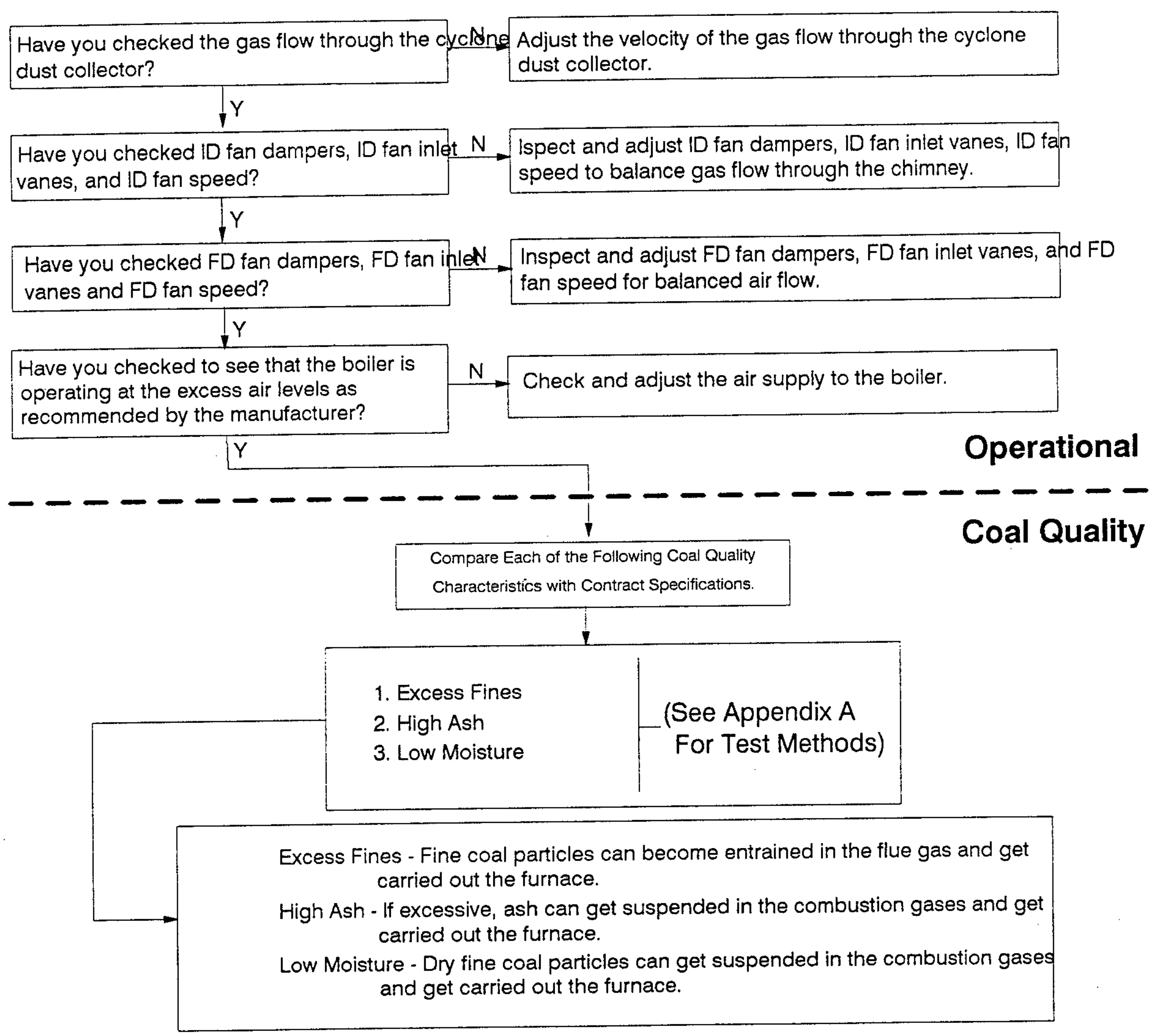


FIG5-73n/3

FIGURE 5-74: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System

(Electrostatic Precipitator)

Have you checked the gas velocity through the precipitator? — N → Check and adjust the gas velocity through the precipitator.

Y ↓

Have you checked the applied voltage across the collecting plates? — N → Check and adjust the applied voltage to the plates.

Y ↓

Have you checked the corona? — N → Check the corona strength.

Y ↓

Have you checked ID fan dampers, ID fan inlet vanes, and ID fan speed? — N → Ispect and adjust ID fan dampers, ID fan inlet vanes, ID fan speed to balance gas flow through the chimney.

Y ↓

Have you checked FD fan dampers, FD fan inlet vanes and FD fan speed? — N → Inspect and adjust FD fan dampers, FD fan inlet vanes, and FD fan speed for balanced air flow.

Y ↓

Have you checked to see that the boiler is operating at the excess air levels as recommended by the manufacturer? — N → Check and adjust the air supply to the boiler.

Y ↓

Operational

Coal Quality

See next page for Coal Quality Section.

FIG5-74n/3

FIGURE 5-74 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

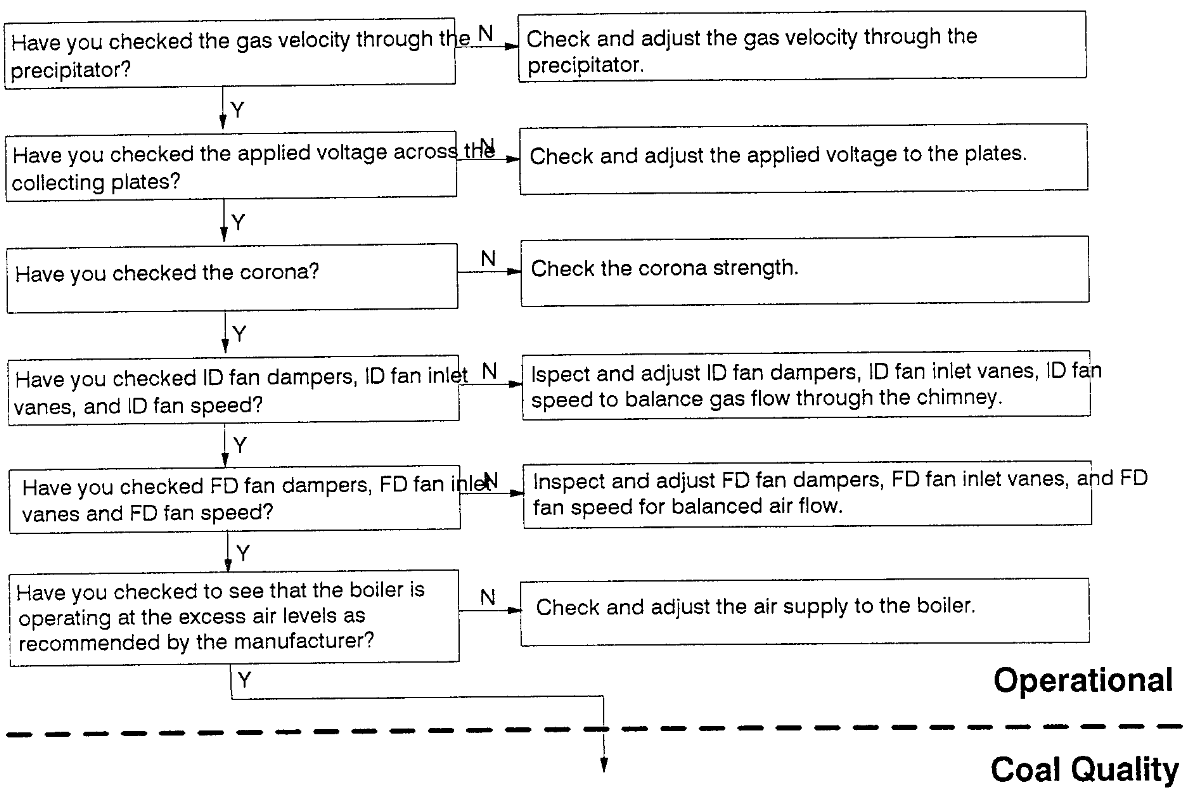
High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG5-74nb/3

FIGURE 5-75: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System

(Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG5-75n/3

FIGURE 5-75 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with eventually wearing away the metal surface.

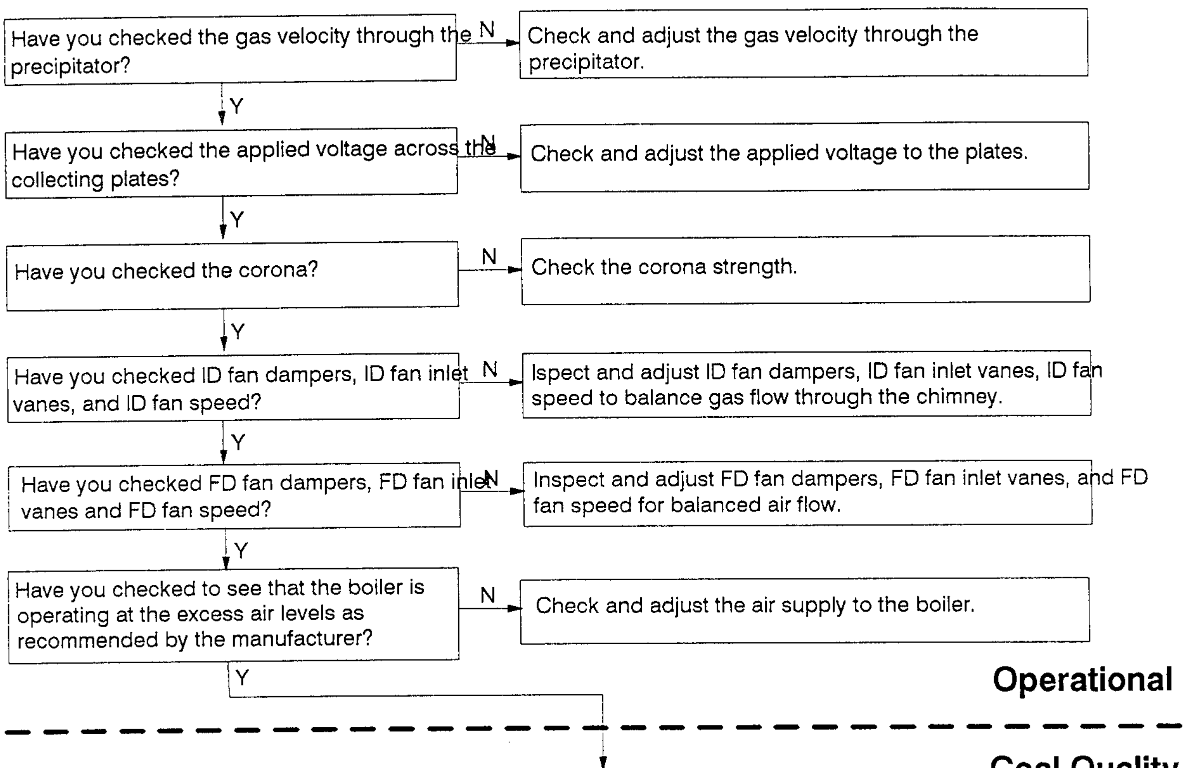
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with and eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with and wear away metal surfaces.

FIG5-75nb/3

FIGURE 5-76: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG5-76n/3

FIGURE 5-76 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)

See previous page for Operational Section.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Fly Ash Resistivity
2. High Ash
3. Low Sulfur
4. Excess Fines
5. Low Moisture

(See Appendix A For Test Methods)

Fly Ash Resistivity - The resistivity of the fly ash is the key parameter which limits the applied voltage and hence the collection efficiency for a given precipitator design and operating configuration.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace. A high calcium content in the ash reduces the effective sulfur trioxide concentration, thereby decreasing precipitator performance. Sulfur trioxide is important in the resistivity mechanism because water molecules in combination with sulfur trioxide are absorbed on the surface of the ash particles and form a conductive film, shich decrease resistivity.

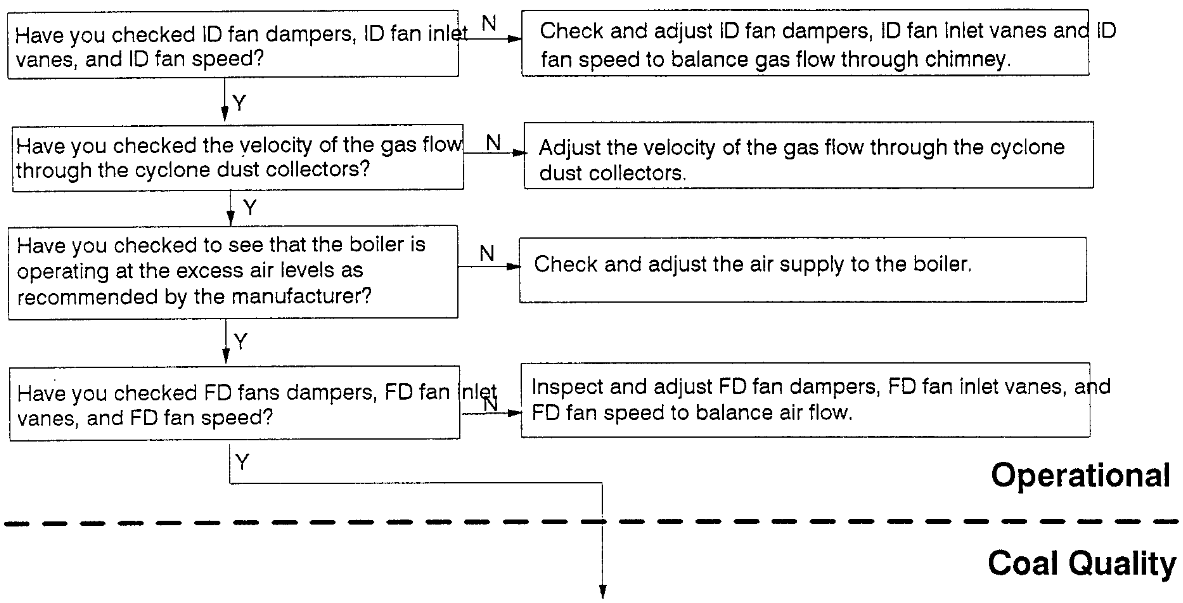
Low Sulfur - Ash from coals low in sulfur is more difficult to precipitate than ash from higher sulfur coals.

Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG5-76nb/3

FIGURE 5-77: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Fly-Ash Recycle



See next page the Coal Quality Section.

FIG5-77n/3

FIGURE 5-77 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Fly-Ash Recycle

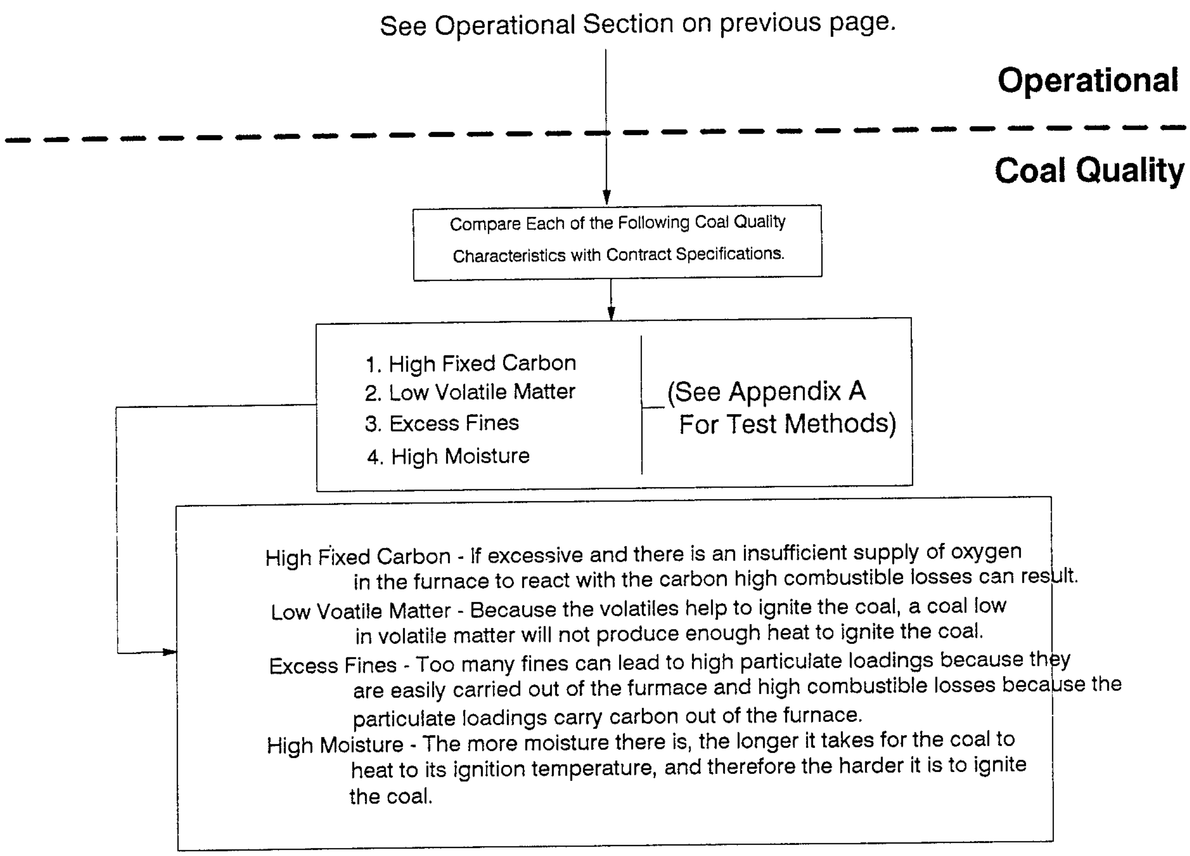


FIG5-77nb/3

FIGURE 5-78: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Ash Hopper/Pit

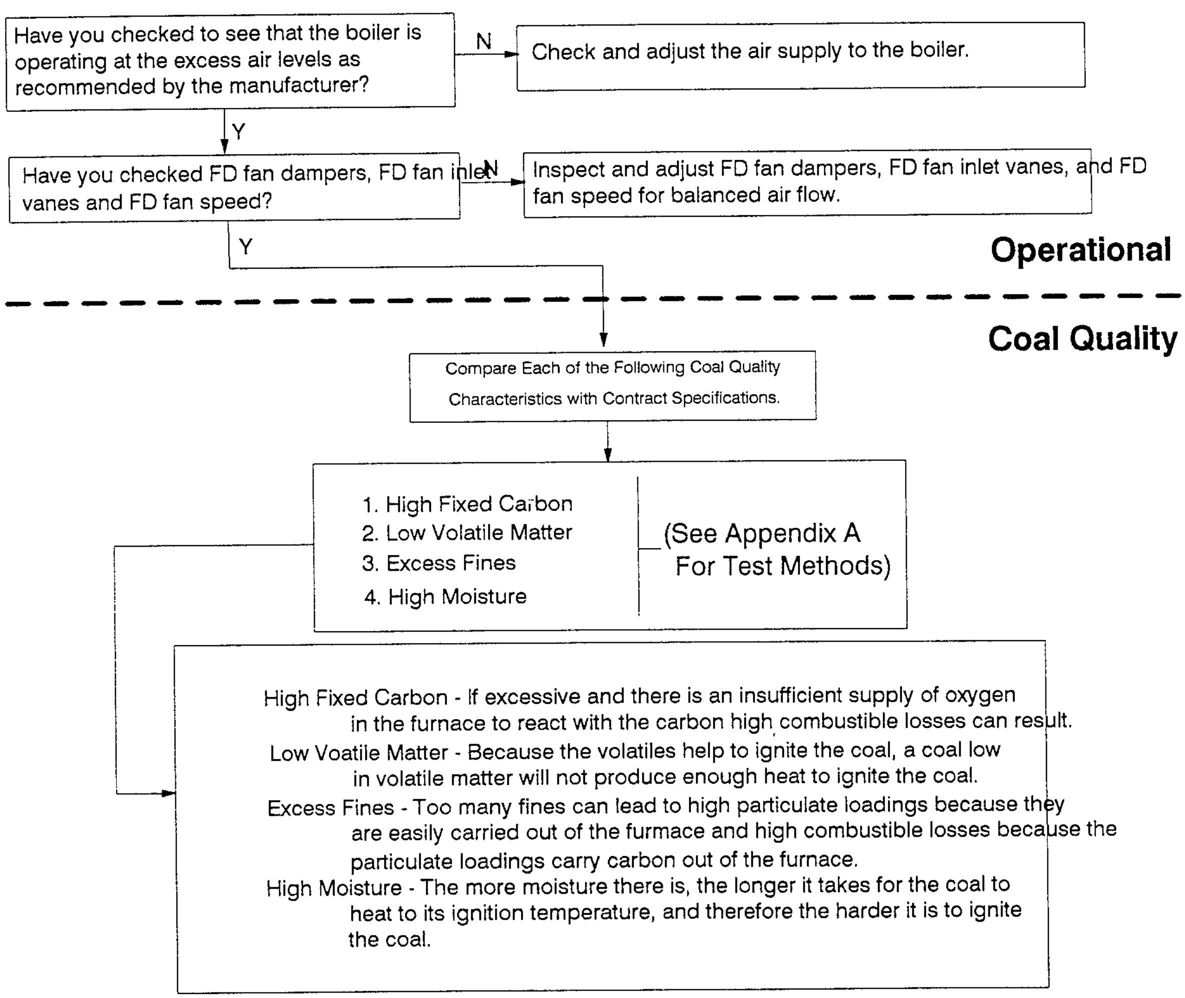


FIG5-78n/3

FIGURE 5-79: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Stack/Chimney

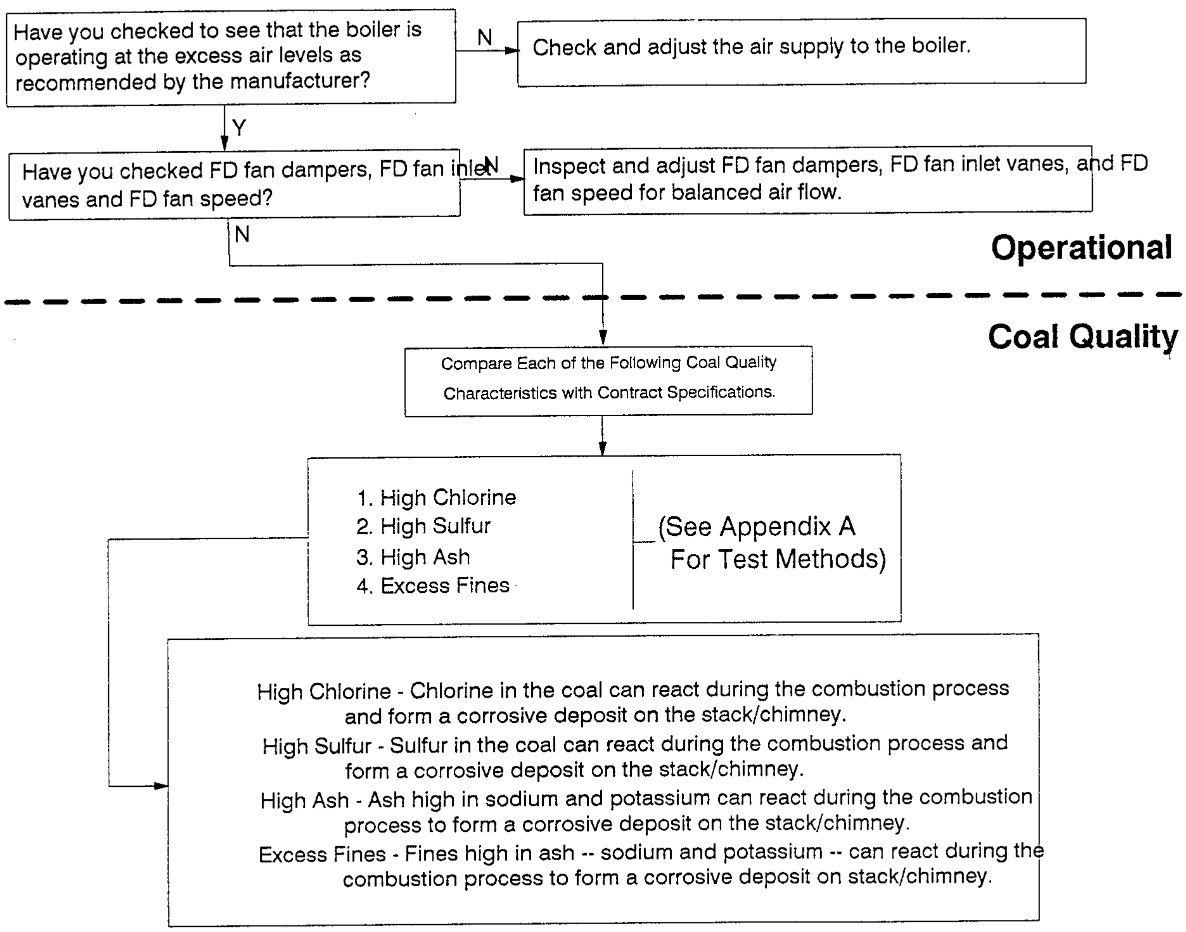
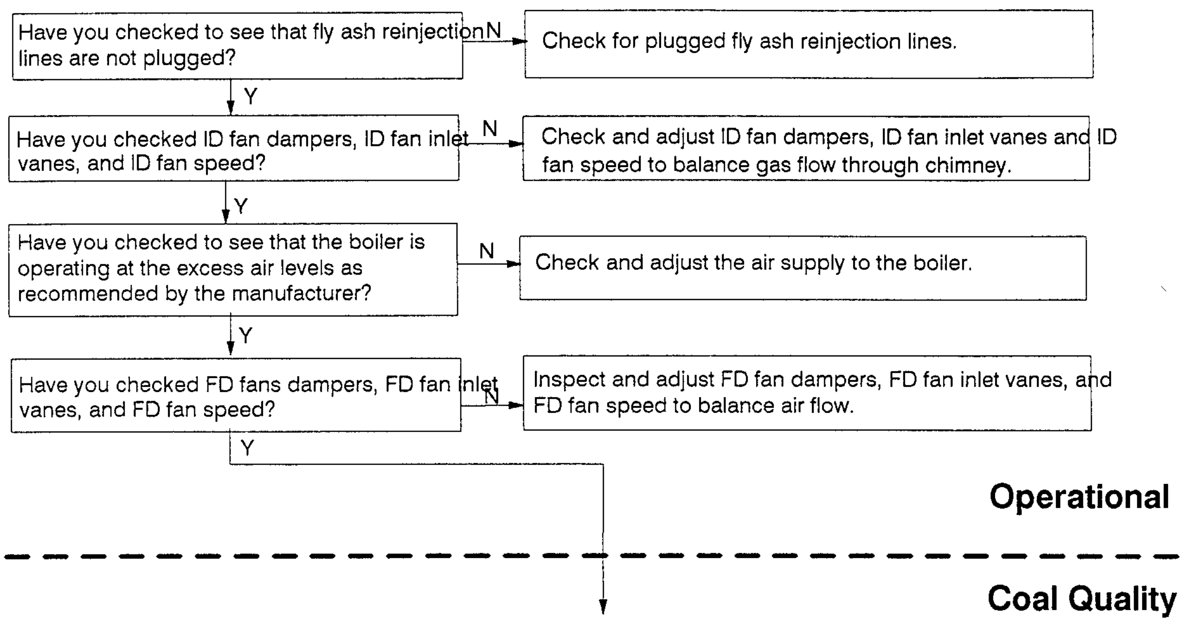


FIG5-79n/3

FIGURE 5-80: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Carbon Burnout In The Stack/Chimney



See next page for Coal Quality Section.

FIG5-80n/3

FIGURE 5-80 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

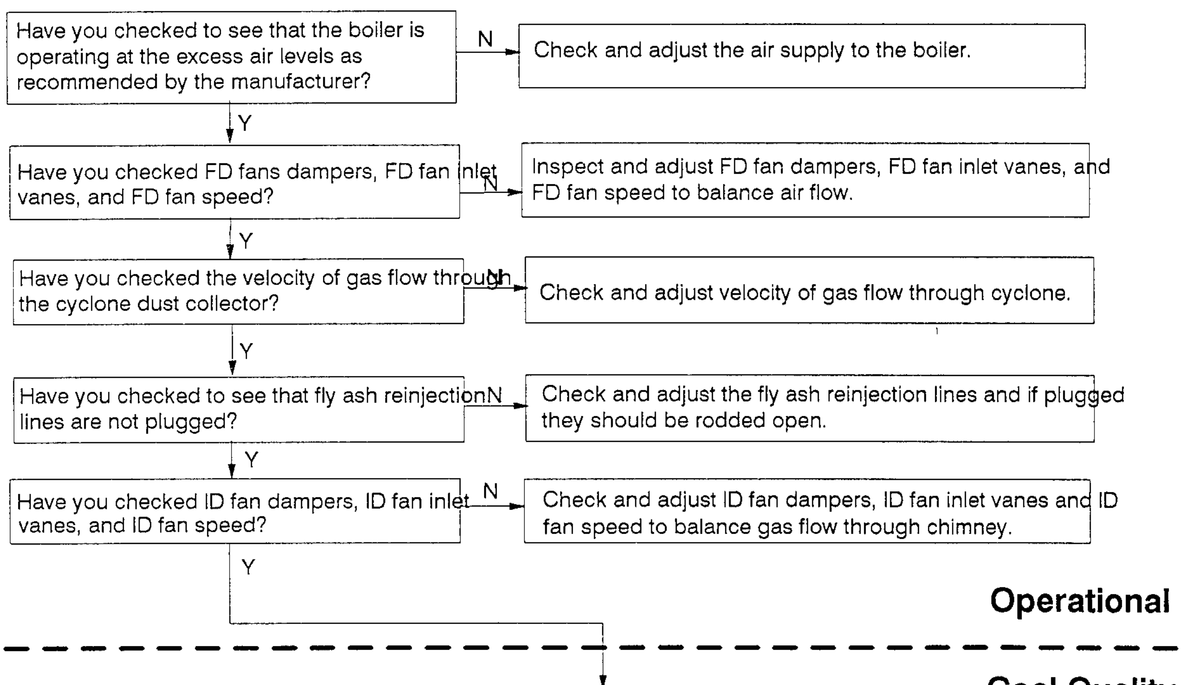
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG5-80nb/3

FIGURE 5-81: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From Stack/Chimney



See next page for Coal Quality Section.

FIG5-81n/3

FIGURE 5-81 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

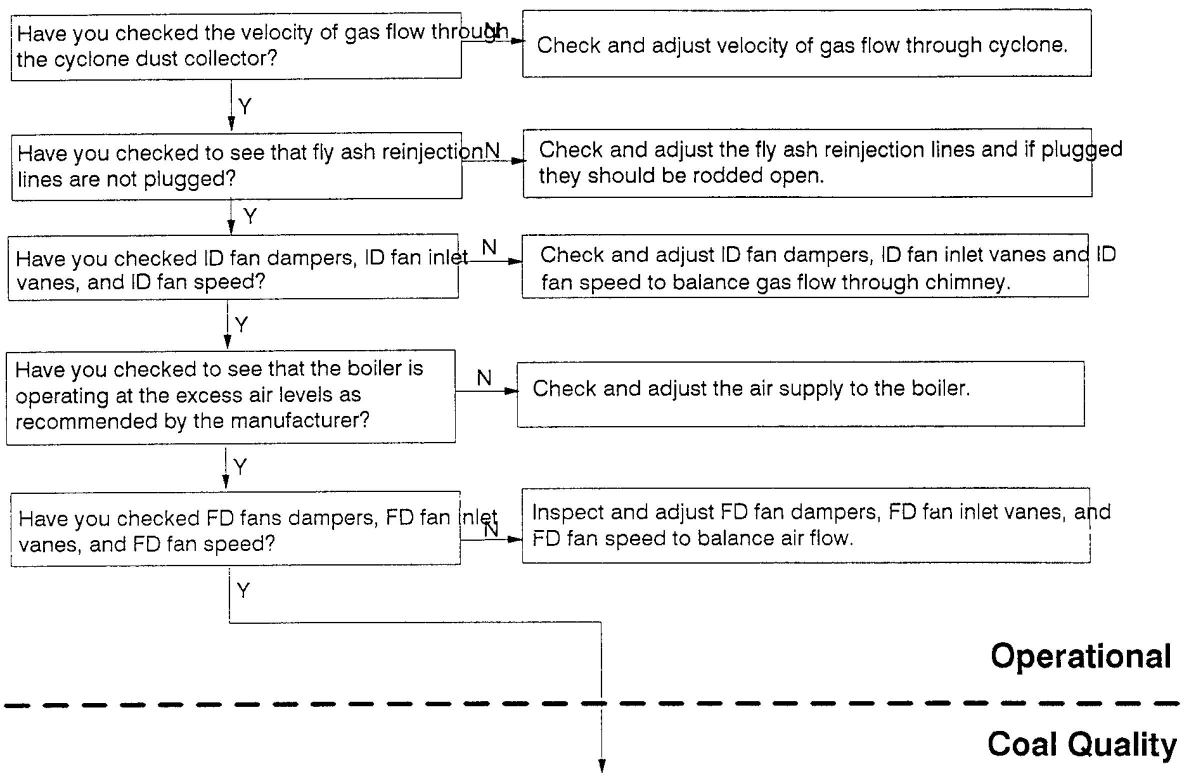
High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG5-81nb/3

FIGURE 5-82: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Diagnosing Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIG5-82n/3

FIGURE 5-82 (CONT'D): PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM
For Diagnosing Excess Particulate Emissions From The Stack/Chimney

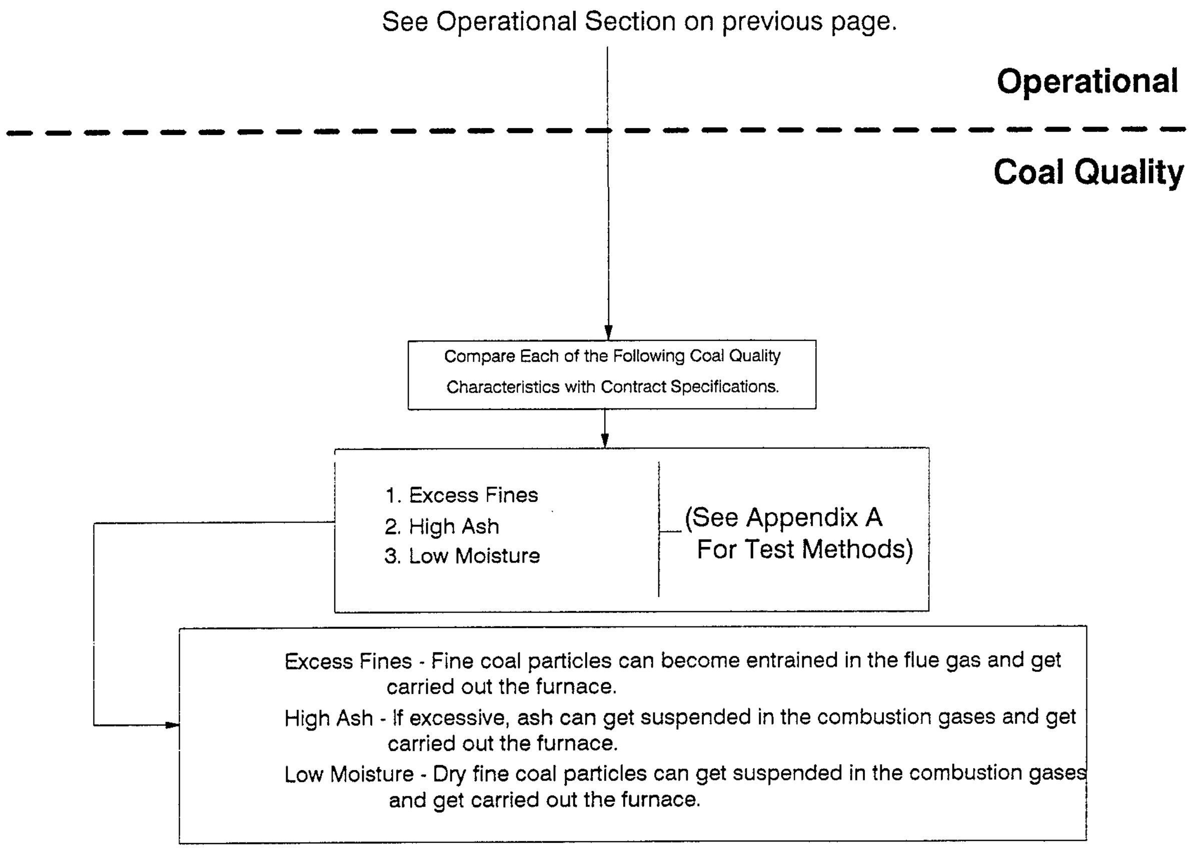


FIG5-82nb/3

FIGURE 5-83: PULVERIZED COAL TROUBLESHOOTING LOGIC DIAGRAM For SO_2 Emissions From The Stack/Chimney

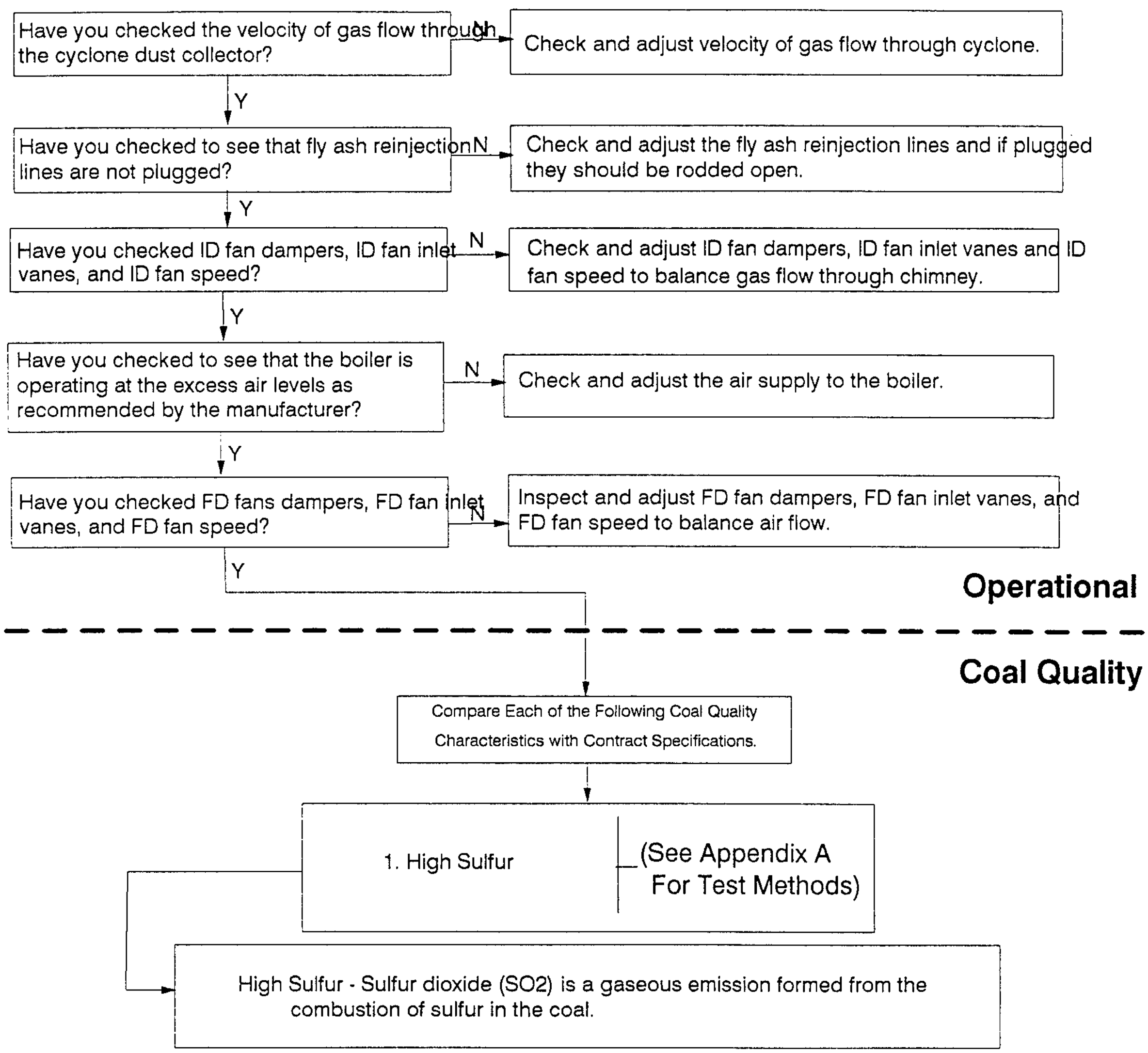


FIG5-83n/3

Appendix F: Atmospheric Fluidized Bed Boiler System Descriptions and Troubleshooting Diagrams

This TSG Appendix deals with identifying and solving potential coal quality-related problems that can be encountered in underfeed stoker-fired boiler systems. A general description of this system is included, but is limited to describing the major components that make up a complete Atmospheric Fluidized Bed Combustor (AFBC). For those interested, more detailed descriptions are provided in reference 11.

This Appendix includes a generalized block flow diagram of a complete overfeed stoker-fired boiler system that:

- identifies the specific components comprising the major subsystems of an overfeed stoker-fired boiler system
- logically presents the flow of coal, flue gas, and ash through the system
- helps determine the existence and location of subsystems and specific components comprising the system.

Following the block flow diagram is a component/symptom table that serves to identify:

- typical symptoms (problems) that may be encountered in the system
- the various components shown in the block flow diagram affected by these symptoms
- the logic diagram to determine whether the problem is due to operational procedures or to out-of-specification coal.

The Troubleshooting Logic Diagrams for this Appendix are presented next. However, before proceeding, the reader is encouraged to read Chapter 2 to understand the structure of each Appendix and how to apply these logic diagrams to diagnosing coal quality-related problems. The Glossary, List of Abbreviations, and References preceding the Appendixes should resolve any questions that arise regarding terminology and laboratory procedures.

F1 System Description

A typical bubbling fluidized bed boiler is shown in Figure 6-1. Much of the boiler itself (often called a "combustor" in fluidized bed nomenclature) and the flue gas train is identical with that found in other solid fuel firing units. The boiler and convective backpasses are similar in design, with soot blowers and mechanical collectors used to remove entrained solids. The air heater, ductwork, fans, and stack are similar to those found in other boilers. The differences center on the bottom of the combustor itself.

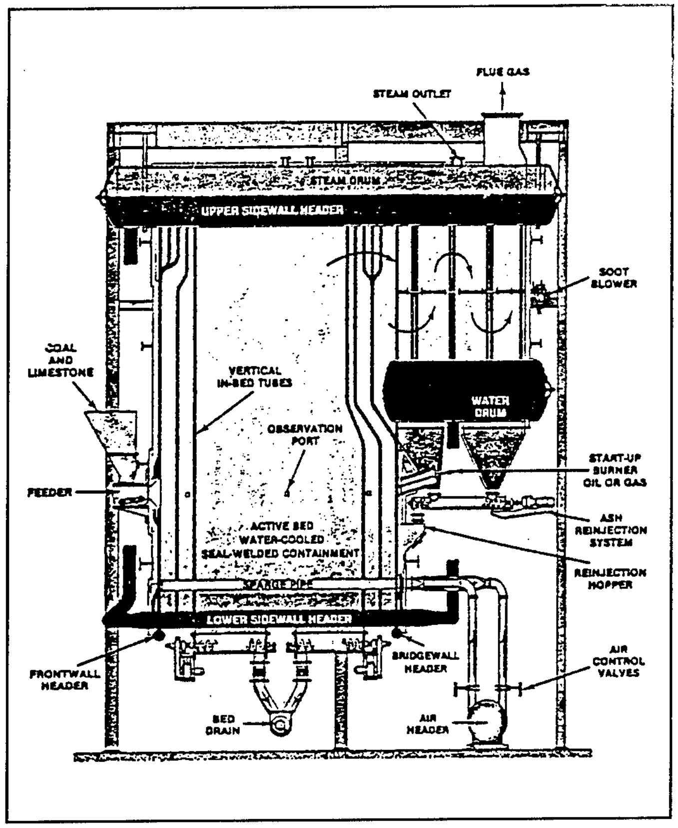


Figure 6-1. Bubbling bed boiler.

Combustor air enters at the bottom of the unit through a distributor to uniformly lift (fluidize) the fuel and bed material. Fluidization occurs whenever air or other fluid passes upward through the solid particles and lifts the solids. Fluidized Bed combustion is becoming increasingly attractive because of several inherent advantages over conventional combustion systems. These advantages are added fuel flexibility, low NOx emissions, and better control of SO_2 emissions.

The main configurations of Fluidized Bed include: bubbling bed with or without in-bed tubes, circulating-fluidized bed (CFB) designs with or without external heat exchangers, and atmospheric or elevated-pressure operation. This Appendix will be limited to the more common atmospheric fluidized bed combustion. In the bubbling bed technology, the lifting of the solids is slight; the solids "float" in the upward moving combustion air. These solids form a "bed" over an air distributor. As the air velocity increases, the bed expands more and more as the solids are lifted higher. At some point, the bed is lifted up and out of the combustion chamber. Circulating FBC's operate with this higher velocity. Figure 6-2 shows circulating bed combustors.

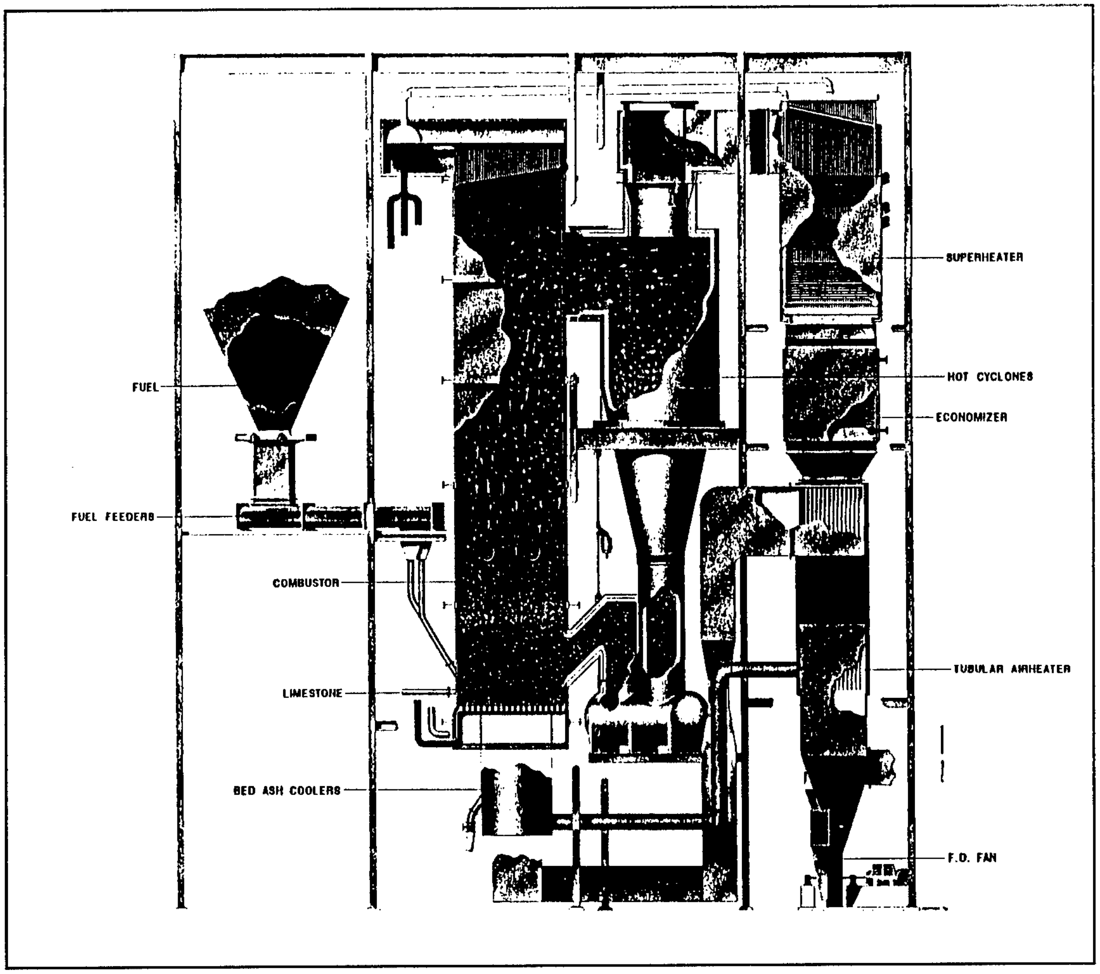


Figure 6-2. Circulating bed boiler.

In a typical FBC unit, solid, liquid, or gaseous fuel or fuels (especially coal and solid waste fuels), together with inert materials (for example, sand, silica, alumina, or ash) and/or a sorbent such as limestone or dolomite are kept suspended (fluidized) through the action of the primary air distributed below the combustor floor.

Turbulence is promoted by fluidization making the entire mass of solids behave much like a fluid. Improved mixing generates heat at a substantially lower and more uniformly distributed temperature than a stoker-fired unit or a pulverized-coal burner. Figure 6-3 shows the fundamental features of a typical FBC.

F2 Block Flow Diagram

The AFBC boiler system has been divided into 15 specific subsystems or components (the performance of which can be significantly impacted by coal quality), sequentially arranged to show:

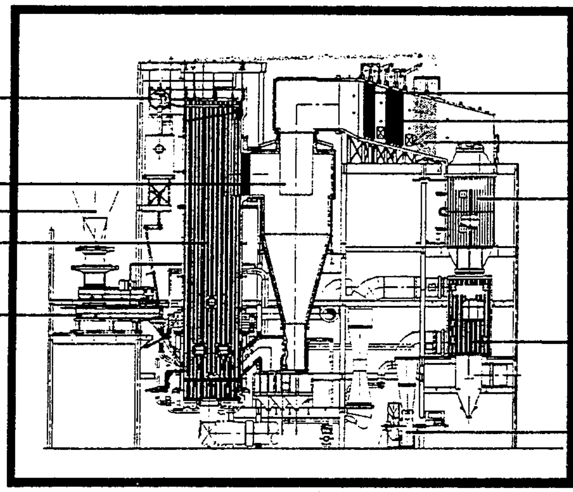


Figure 6-3. Fundamental features of fluidized bed combustor.

- coal flow through the coal handling equipment
- limestone flow through the limestone handling equipment
- flue gas flow through the boiler/components, flyash recycle, the induced draft fan, and chimney/stack
- ash discharge to the ash hopper/pit.

These specific components are identified in Figure 6-4. The first four components have been grouped collectively under a category entitled coal-handling equipment. The coal handling equipment includes all components that process the coal from its delivery on site to the fluidized bed. It includes equipment that, depending on plant design, may include:

- coal reclaim systems such as belt feeders, vibrating feeders, screw feeders, and reciprocating feeders
- coal feed conveyors such as belt conveyors, screw conveyors, bucket conveyors, redler conveyors, and chutes
- components that store the coal such as bunkers and hoppers
- coal feeders that transport coal to the coal hopper

The next two components are grouped under a category called "Limestone Handling Equipment." The limestone handling equipment includes the Bunker where it is stored, and the feeder linestore.

The next four components have been loosely grouped under the category entitled "Boiler/Components." Again, it includes equipment such as:

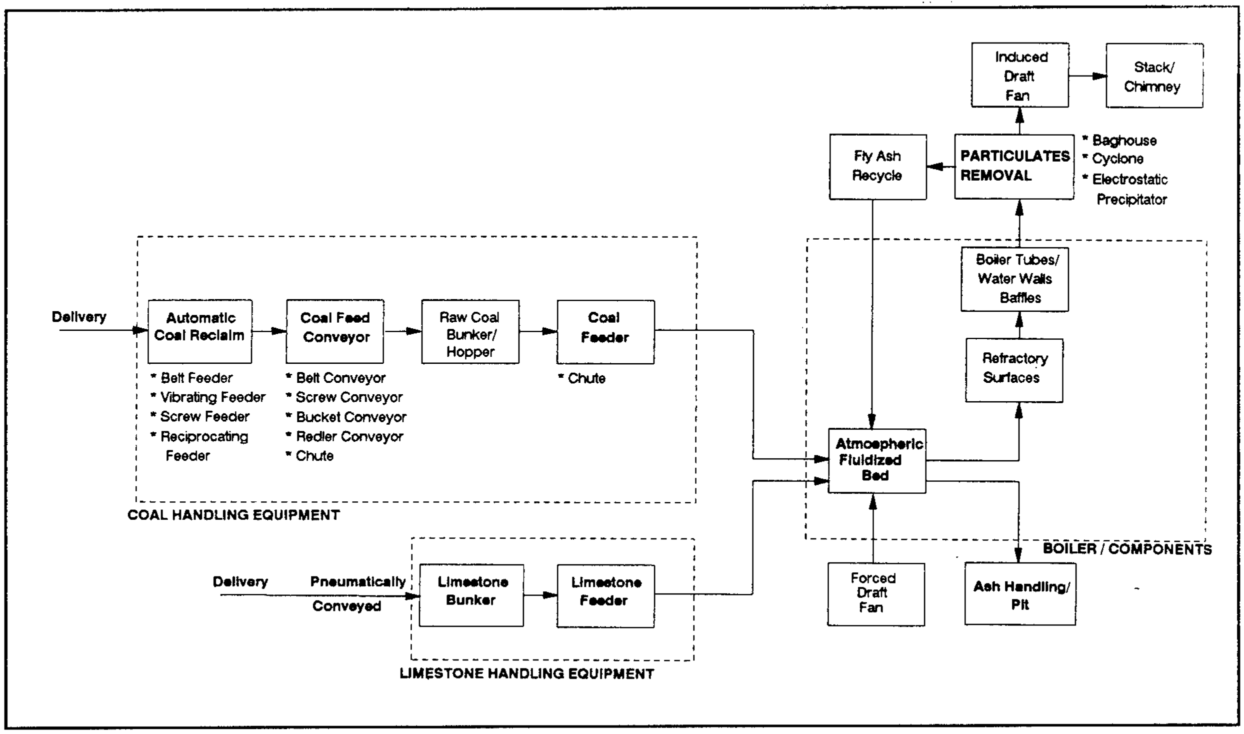


Figure 6-4. Atmospheric fluidized bed boiler system components block flow diagram.

- forced draft fan
- the fluid bed (combustor)
- refractory surfaces
- heat transfer surfaces (boiler tubes, water walls, and baffles).

The next two blocks represent the flyash recycle and particulate removal.

Three particulate removal options separately or in combination will be considered: Mechanical Dust Collectors (cyclones), electrostatic precipitators, and baghouses.

The next subsystem identified in the block flow diagram is the fan subsystem. AFBCs use a number of fans to move air and flue gas. The major fan types addressed in the guide include:

- forced draft (FD) fans, which supply air to fluid bed
- induced draft (ID) fans, which withdraw flue gas from the furnace and balance furnace pressure.

All the fans can be impacted by changes in coal quality.

The final subsystems addressed in the guide include those components supplied to handle ash. Specific components include the chimney/stack and the ash hopper/pit.

F3 Troubleshooting Logic

The component/symptom guide table (Figure 6-5) serves to identify:

- Typical symptoms (problems) that may be encountered in AFBC systems. These symptoms are arranged horizontally along the top of the table.
- The various components shown in the block flow diagram affected by these symptoms. These components are listed down the left hand side of the table in the same logical fashion as they are arranged in the block flow diagram.
- The location of the logic diagrams.

The remainder of this Appendix consists of 83 logic diagrams, arranged by component and by all the symptoms that can affect that component.

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	UNEVEN BURNING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE	SO2 EMISSIONS
COAL HANDLING EQUIPMENT																
Automatic Coal Reclaim																
1) Belt Feeder	● 6-6	● 6-7	● 6-8	● 6-9												
2) Vibrating Feeder	● 6-10	● 6-11	● 6-12	● 6-13												
3) Screw Feeder	● 6-14	● 6-15	● 6-16	● 6-17												
4) Reciprocating Feeder	● 6-18	● 6-19	● 6-20	● 6-21												
Coal Feed Conveyor																
1) Belt Conveyor	● 6-22	● 6-23	● 6-24	● 6-25												
2) Screw Conveyor	● 6-26	● 6-27	● 6-28	● 6-29												
3) Bucket Conveyor	● 6-30	● 6-31	● 6-32	● 6-33												
4) Redler Conveyor	● 6-34	● 6-35	● 6-36	● 6-37												
5) Chute		● 6-38	● 6-39	● 6-40												

Figure 6-5. Atmospheric fluidized bed combustor—component system guide (part 1).

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	UNEVEN BURNING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE	SO2 EMISSIONS
COAL HANDLING EQUIP.(CONT																
Coal Feeders																
Chute		● 6-41	● 6-42	● 6-43												
Coal Bunker		● 6-44	● 6-45	● 6-46												
Coal Hopper		● 6-47	● 6-48	● 6-49												
Limestone Handling																
Limestone Bunker/Hopper		● 6-50	● 6-51	● 6-52												
Limestone Feeder		● 6-53														
BOILER / COMPONENTS																
Boiler			● 6-54							● 6-55						
1) Fluidized Bed					● 6-56											
2) Refractory Surfaces					● 6-57							● 6-58	● 6-59			
3) Boiler Tubes/Water Walls					● 6-60							● 6-61	● 6-62	● 6-63		
4) Baffles					● 6-64							● 6-65	● 6-66	● 6-67		

Figure 6-5. Atmospheric fluidized bed combustor—component system guide (part 2).

COMPONENT	EXCESS WEAR	PLUGGAGE	INSUFFICIENT CAPACITY	ERRATIC FEEDING	CORROSION	UNEVEN ASH BED	UNEVEN BURNING	CLINKERS	CARBON BURNOUT	REDUCED EFFICIENCY	SMOKING	EROSION	SLAGGING/SPALLING	FOULING	EXCESS PARTICULATE	SO2 EMISSIONS
FANS																
1) Forced Draft			● 6-68								● 6-69					
2) Induced Draft			● 6-70		● 6-71						● 6-72	● 6-73				
PARTICULATE REMOVAL																
1) Baghouse									● 6-74						● 6-75	
2) Cyclone									● 6-76			● 6-77			● 6-78	
3) Electrostatic Precipitator									● 6-79			● 6-80			● 6-81	
ASH HANDLING																
1) Fly Ash Recycle									● 6-82							
2) Ash Hopper/Pit									● 6-83							
Stack/Chimney					● 6-84				● 6-85		● 6-86				● 6-87	● 6-88

Figure 6-5. Atmospheric fluidized bed combustor—component system guide (part 3).

FIGURE 6-6: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim (Belt Feeder)

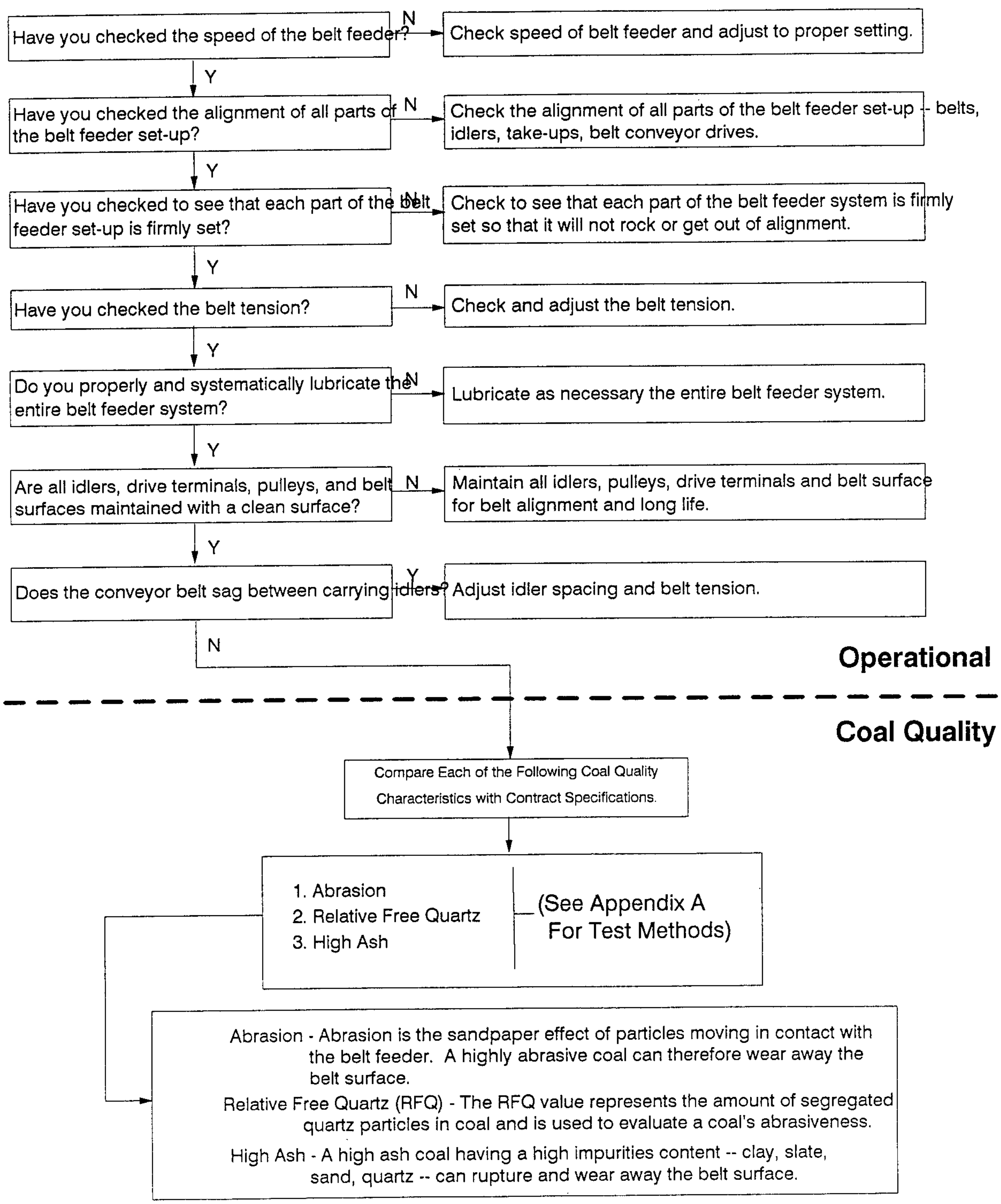


Fig 6-6n/1

FIGURE 6-7: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Belt Feeder)

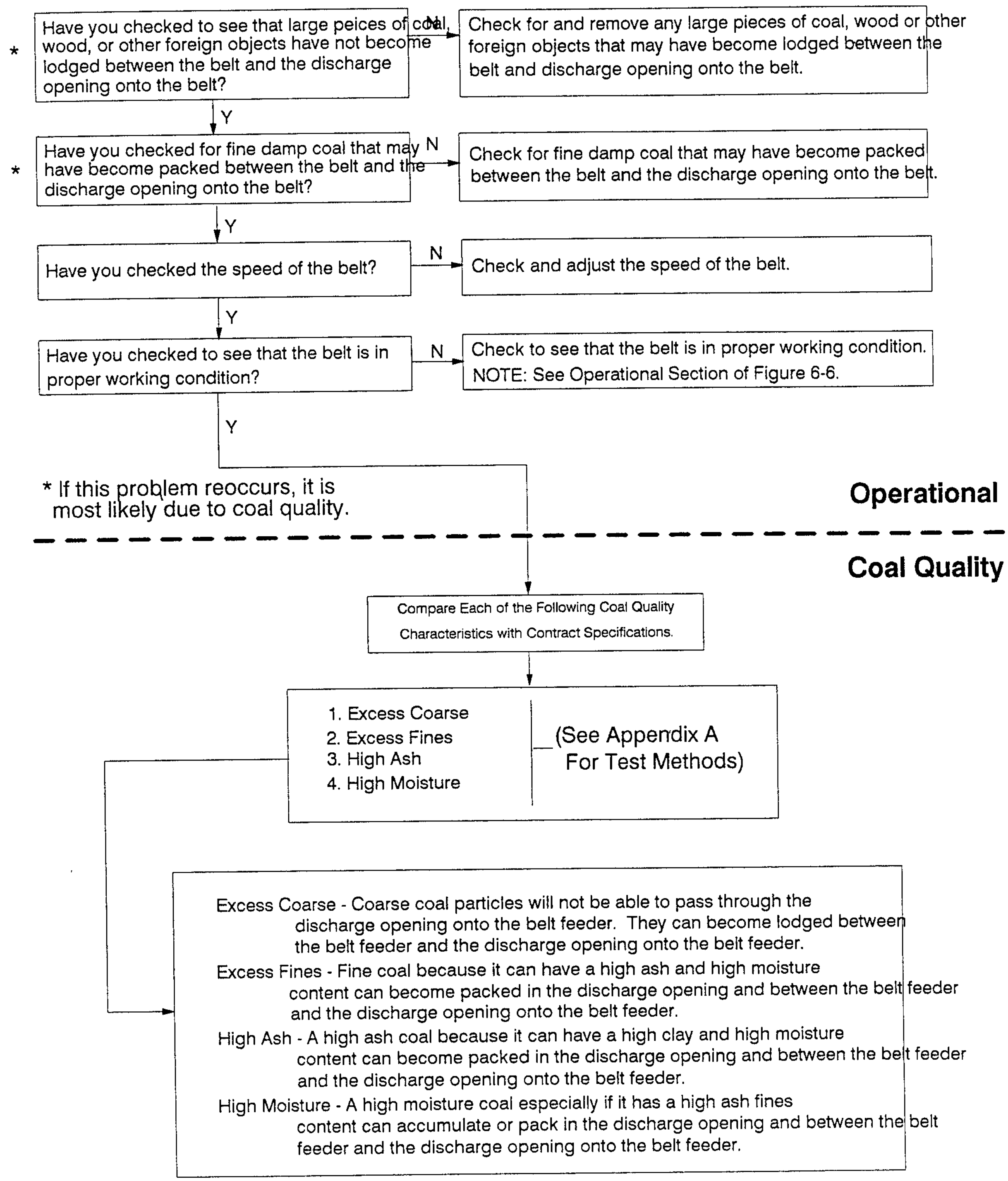


FIG6-7n/1

FIGURE 6-8: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Belt Feeder)

Have you checked to see that coal is not spilling over the sides of the belt?
N → Check to see that coal is not spilling over the sides of the belt.
Y ↓

* Have you checked to see that fine moist coal is not sticking to the belt?
N → Check for fine moist coal sticking to the belt.
Y ↓

Have you checked to see that the belt is in good condition?
N → Check working condition of the belt. NOTE: See Operational Section of Figure 6-6.
Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG6-8n/1

FIGURE 6-9: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Belt Feeder)

* Have you checked to see that fine damp coal is not sticking to the belt?

N → Check to see that fine damp coal is not sticking to the belt.

Y ↓

Have you checked to see that coal is not spilling over the sides of the belt?

N → Check to see that coal is not spilling over the sides of the belt.

Y ↓

Have you checked the condition of the belt and the conveyor belt system?

N → Check the working condition of the belt.
NOTE: See Operational Section of Figure 6-6.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects will not be able to pass through the discharge opening onto the belt feeder. They can become lodged between the belt feeder and the discharge opening onto the belt feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in the discharge opening and between the belt feeder and the discharge opening onto the belt feeder.

FIG6-9n/1

FIGURE 6-10: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim

(Vibrating Feeder)

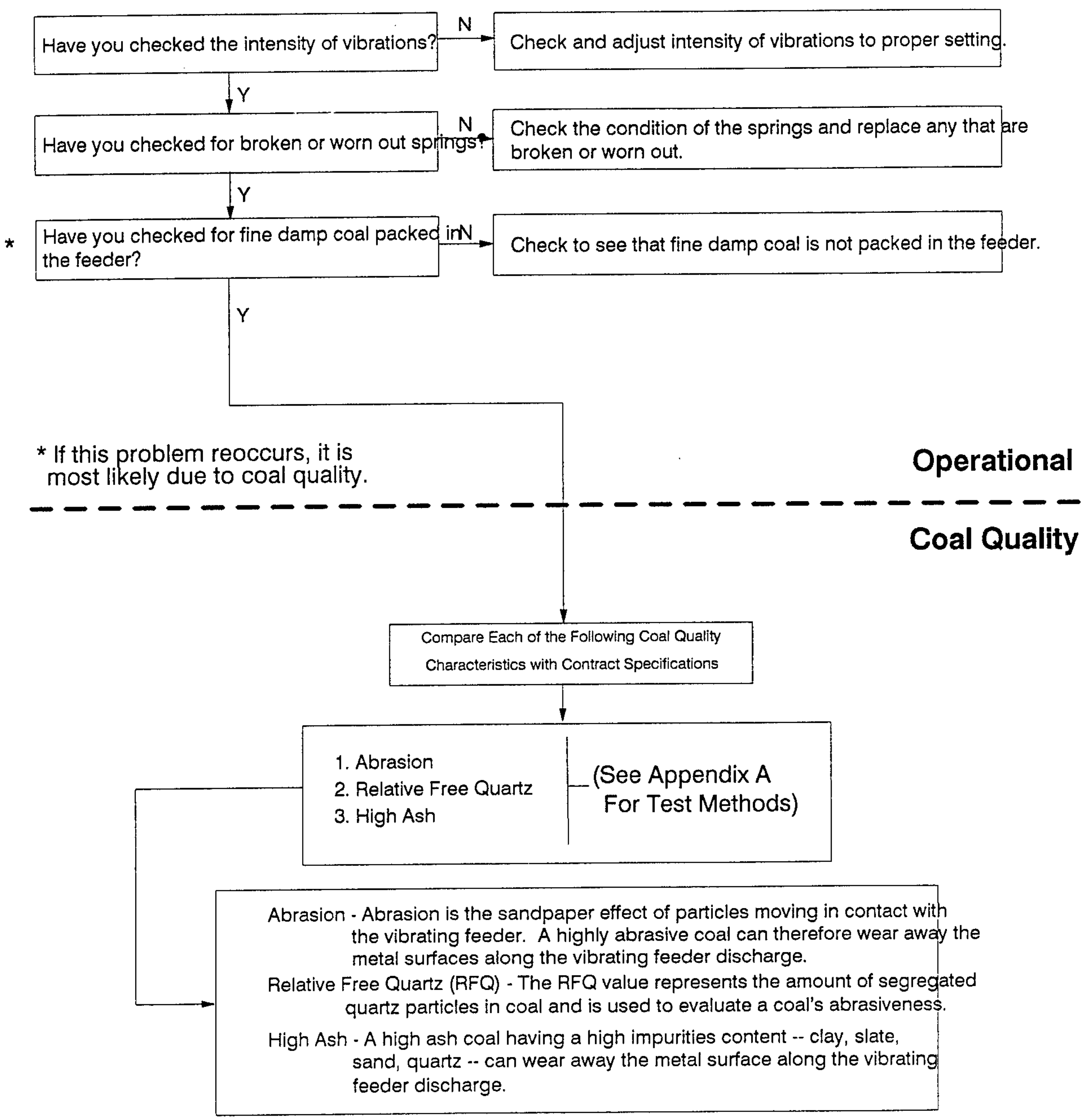


FIG6-10n/1

FIGURE 6-11: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Vibrating Feeder)

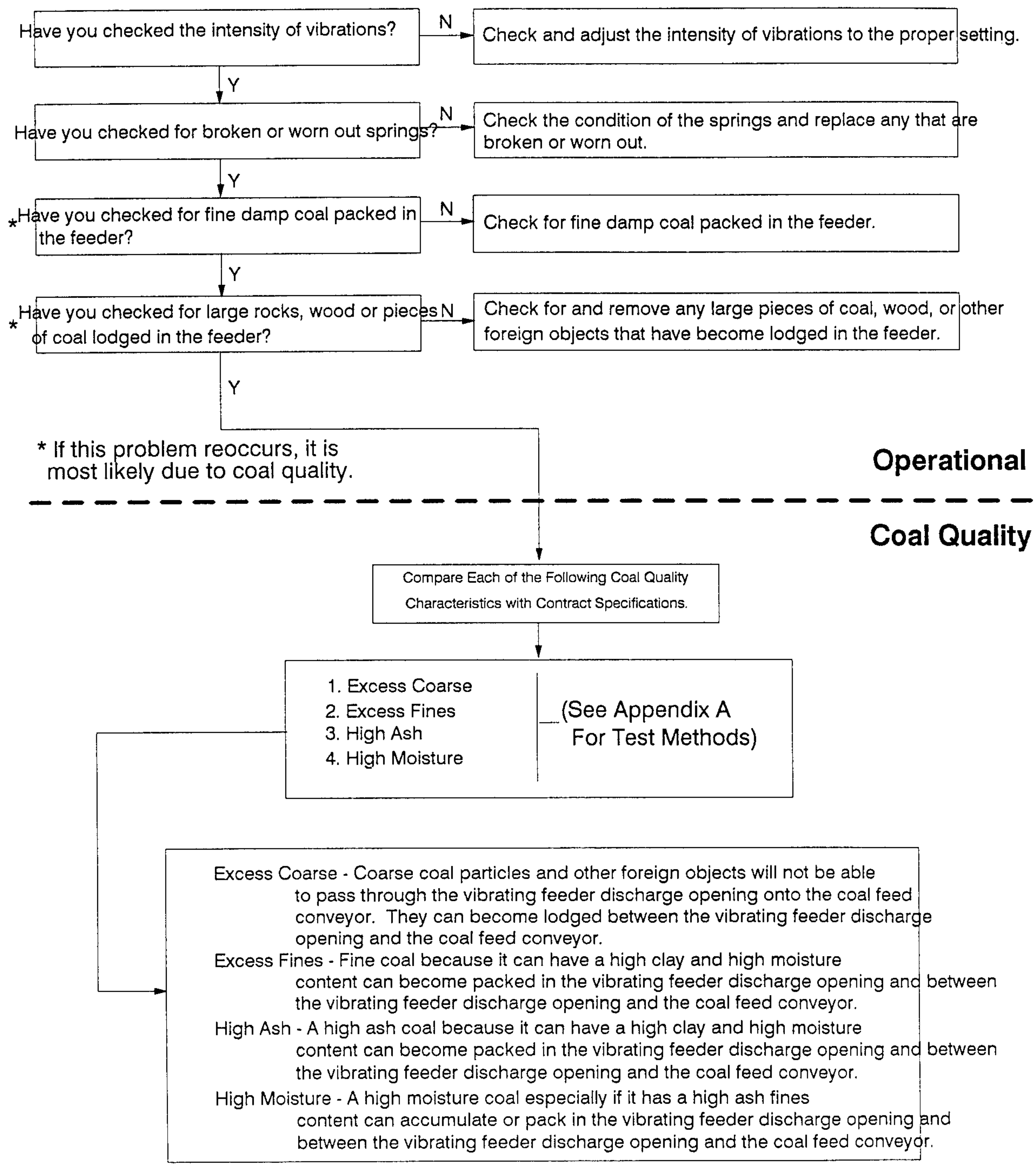


FIG6-11n/1

FIGURE 6-12: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity Of The Automatic Coal Reclaim
(Vibrating Feeder)

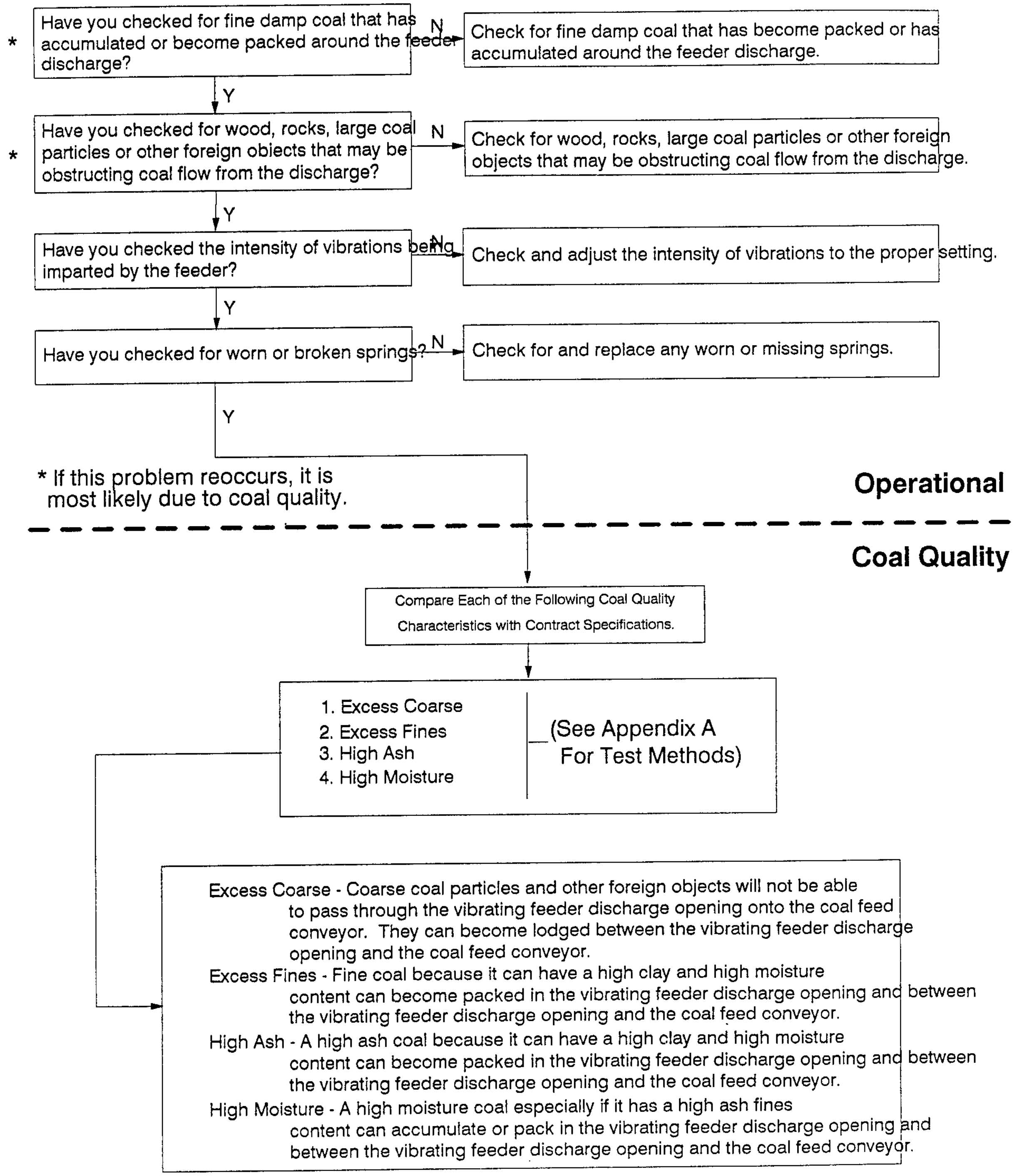


FIG6-12n/1

FIGURE 6-13: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Vibrating Feeder)

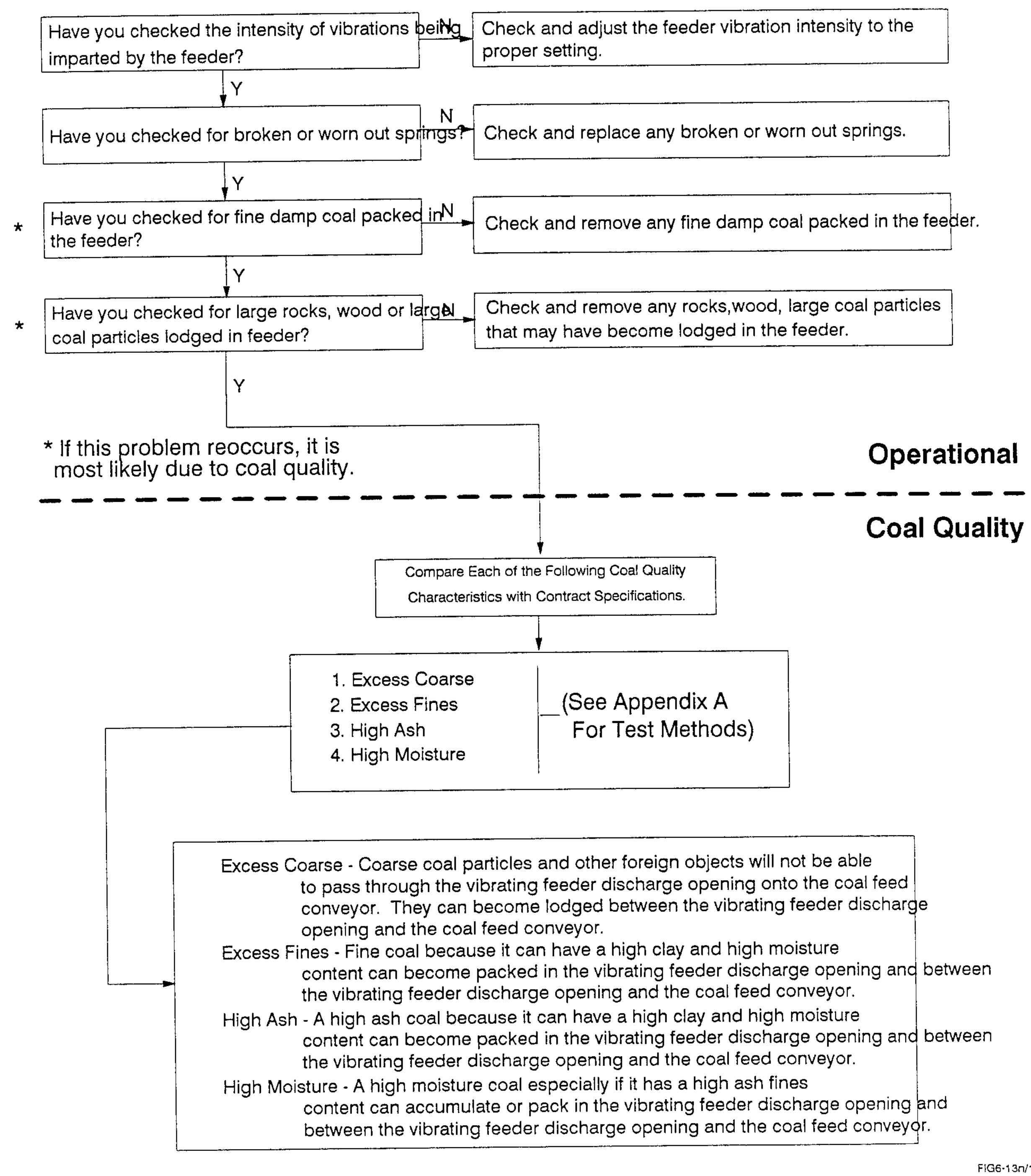


FIGURE 6-14: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Excess Wear Of The Automatic Coal Reclaim
(Screw Feeder)

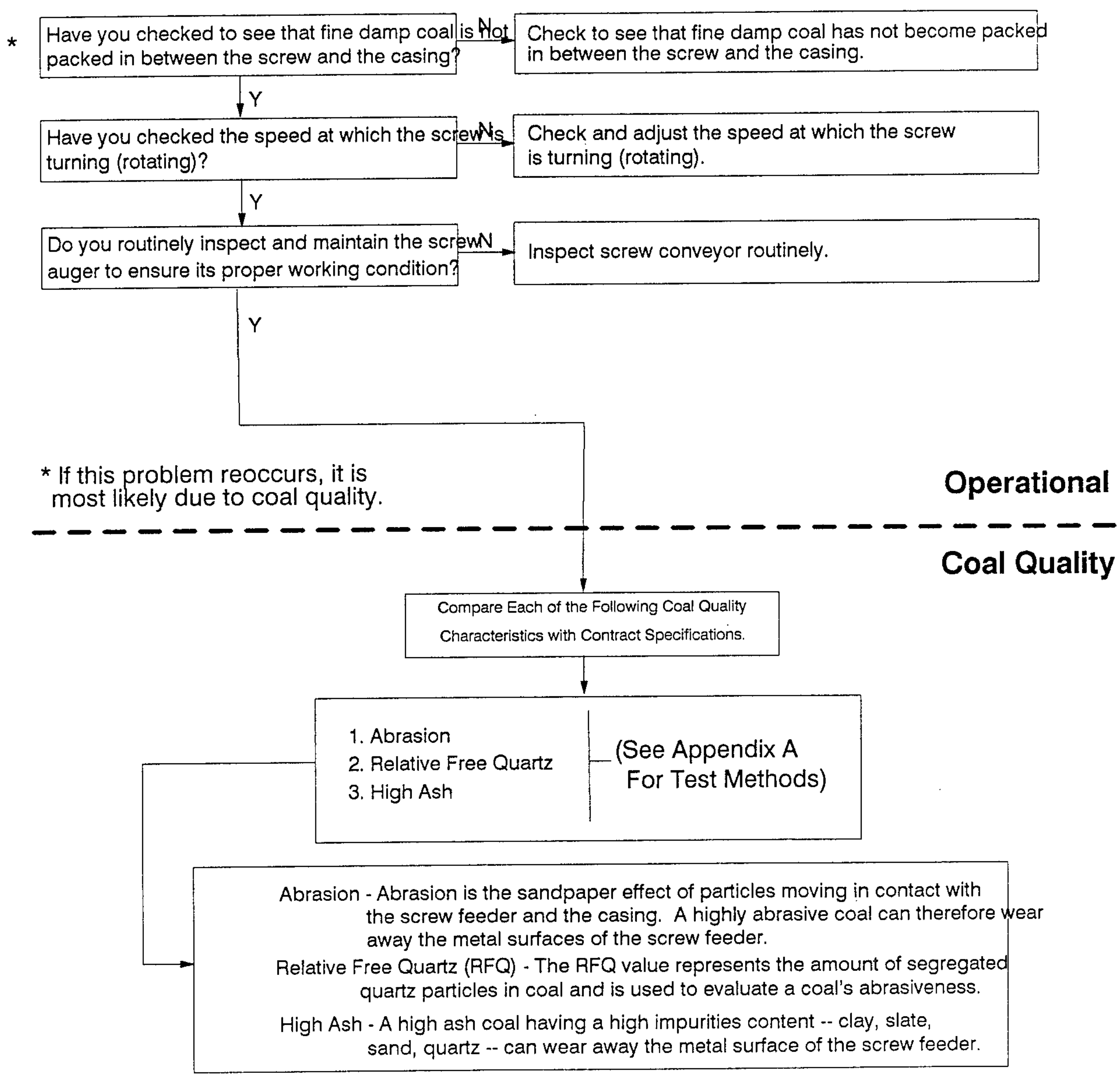


FIG6-14n/1

FIGURE 6-15: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Screw Feeder)

Is the auger turned on?	N →	Turn on the auger.
Y ↓ Have you checked the speed of the screw?	N →	Check and adjust the speed of the screw.
Y ↓ * Have you checked for large rocks, wood, pieces of coal or other foreign objects preventing coal flow onto the coal feed conveyor?	N →	Check for and remove any large rocks, wood, pieces of coal or or other foreign objects preventing coal flow onto the coal feed conveyor.
Y ↓ * Have you checked for frozen coal?	N →	Check for and dislodge any frozen coal.
Y ↓ * Have you checked for fine damp coal packed between the screw and the casing?	N →	Check for fine damp coal that may be packed between the screw and the casing.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw feeder and the casing surrounding the screw feeder.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw feeder and the casing surrounding the screw feeder.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw feeder and the casing surrounding the screw feeder.

FIG6-15n/1

FIGURE 6-16: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Screw Feeder)

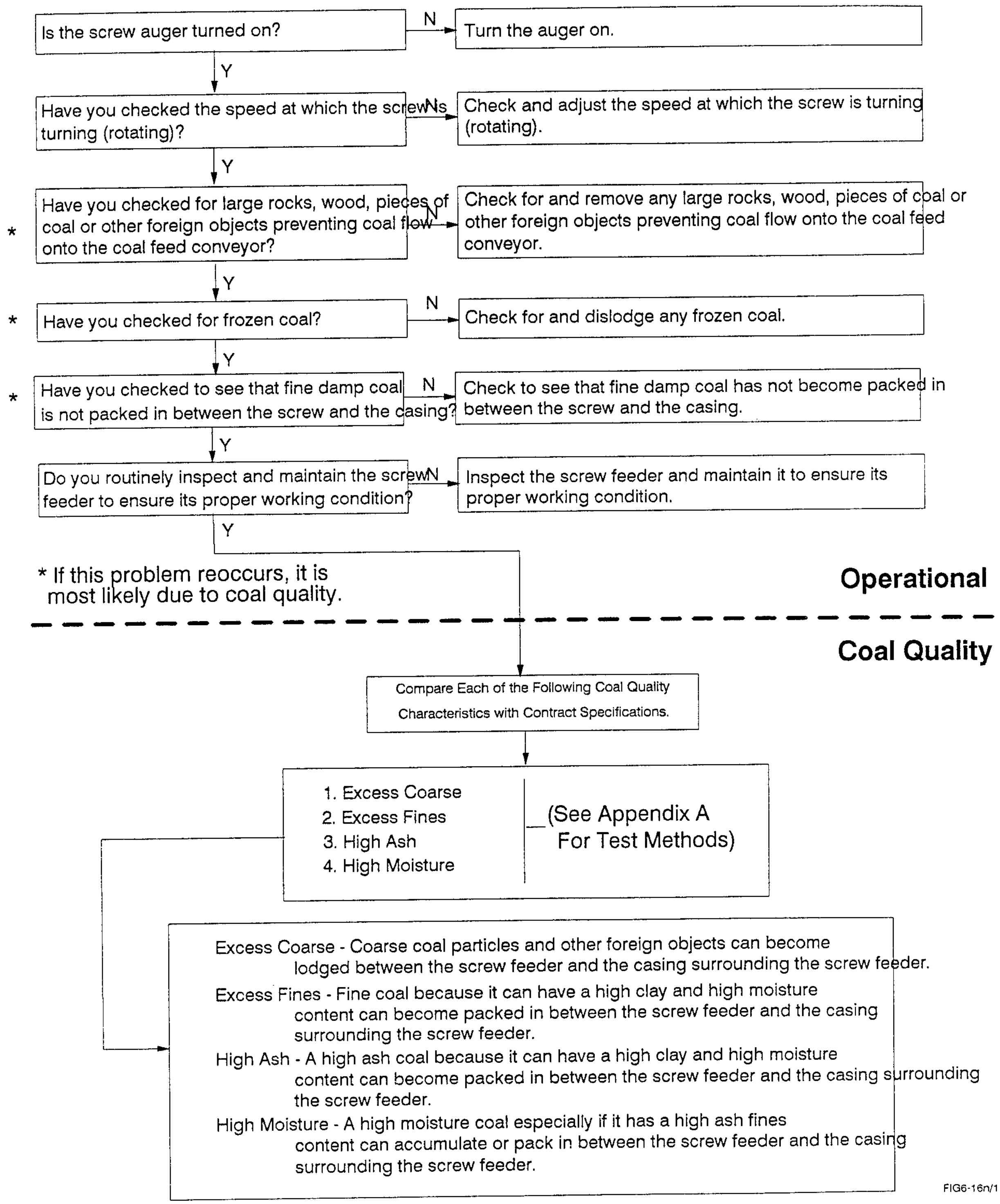


FIGURE 6-17: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Screw Feeder)

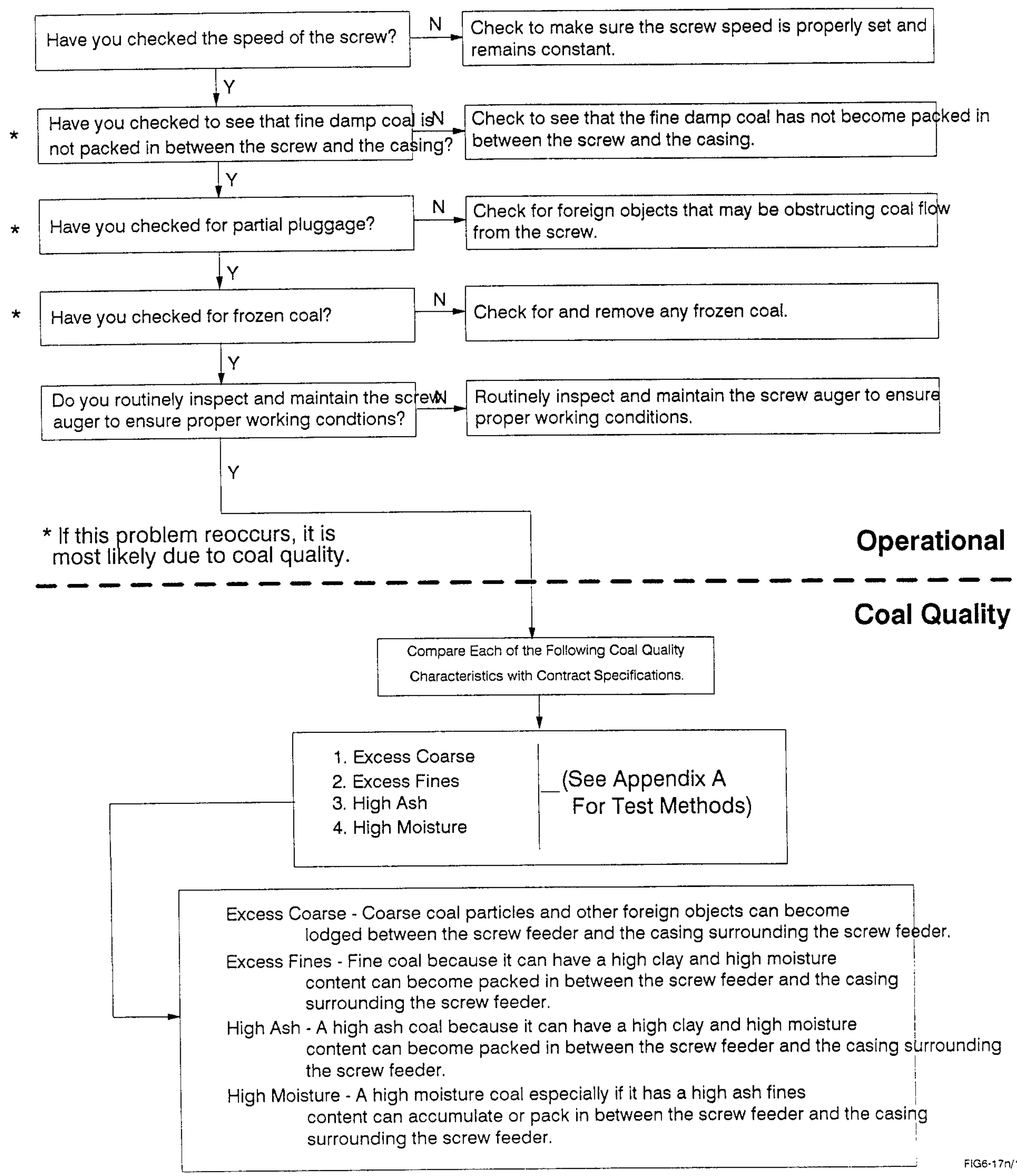


FIG6-17n/1

FIGURE 6-18: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Automatic Coal Reclaim (Reciprocating Feeder)

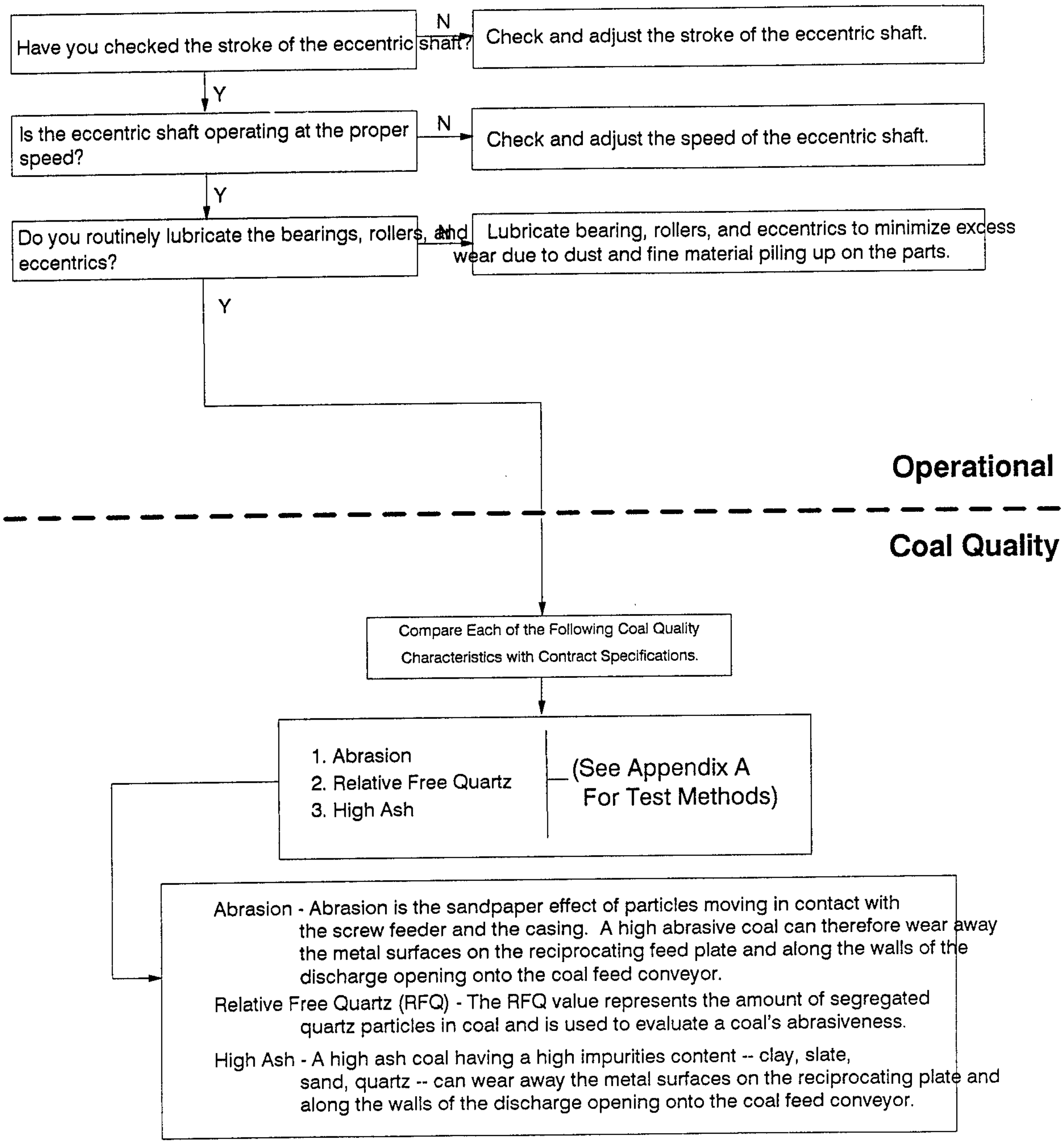


FIG6-18n/1

FIGURE 6-19: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Automatic Coal Reclaim (Reciprocating Feeder)

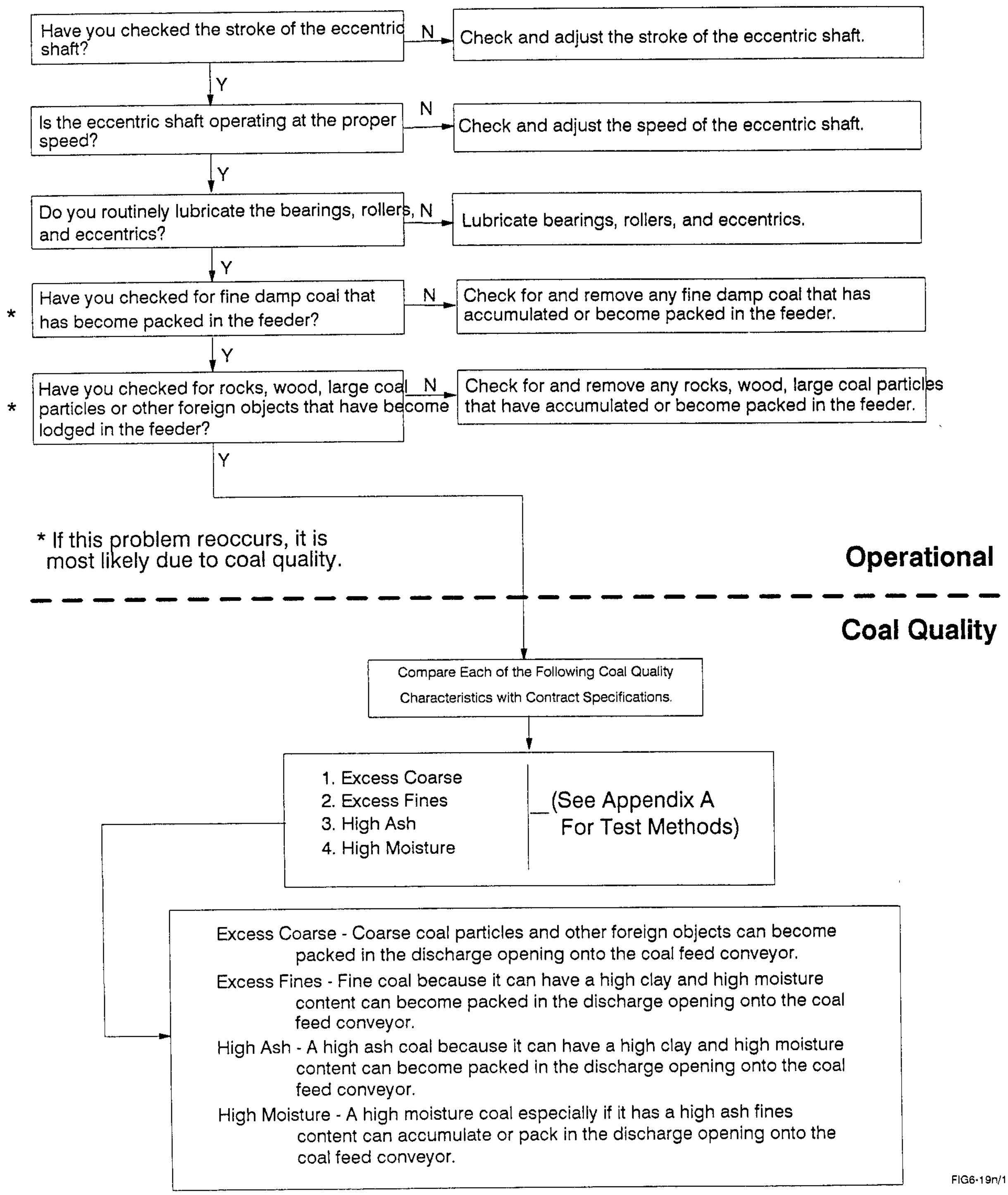


FIGURE 6-20: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Automatic Coal Reclaim (Reciprocating Feeder)

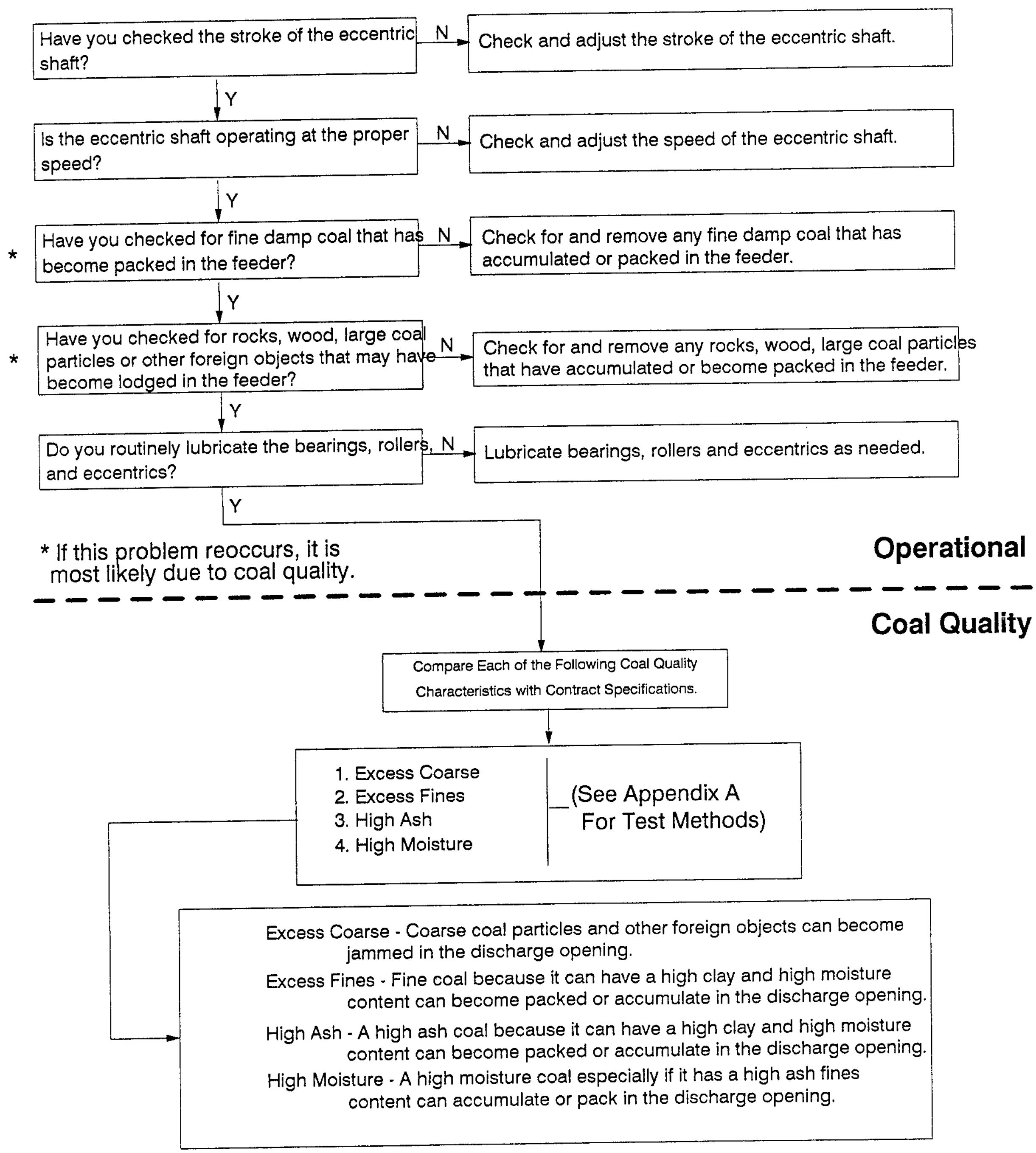


FIG6-20n/1

FIGURE 6-21: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Automatic Coal Reclaim (Reciprocating Feeder)

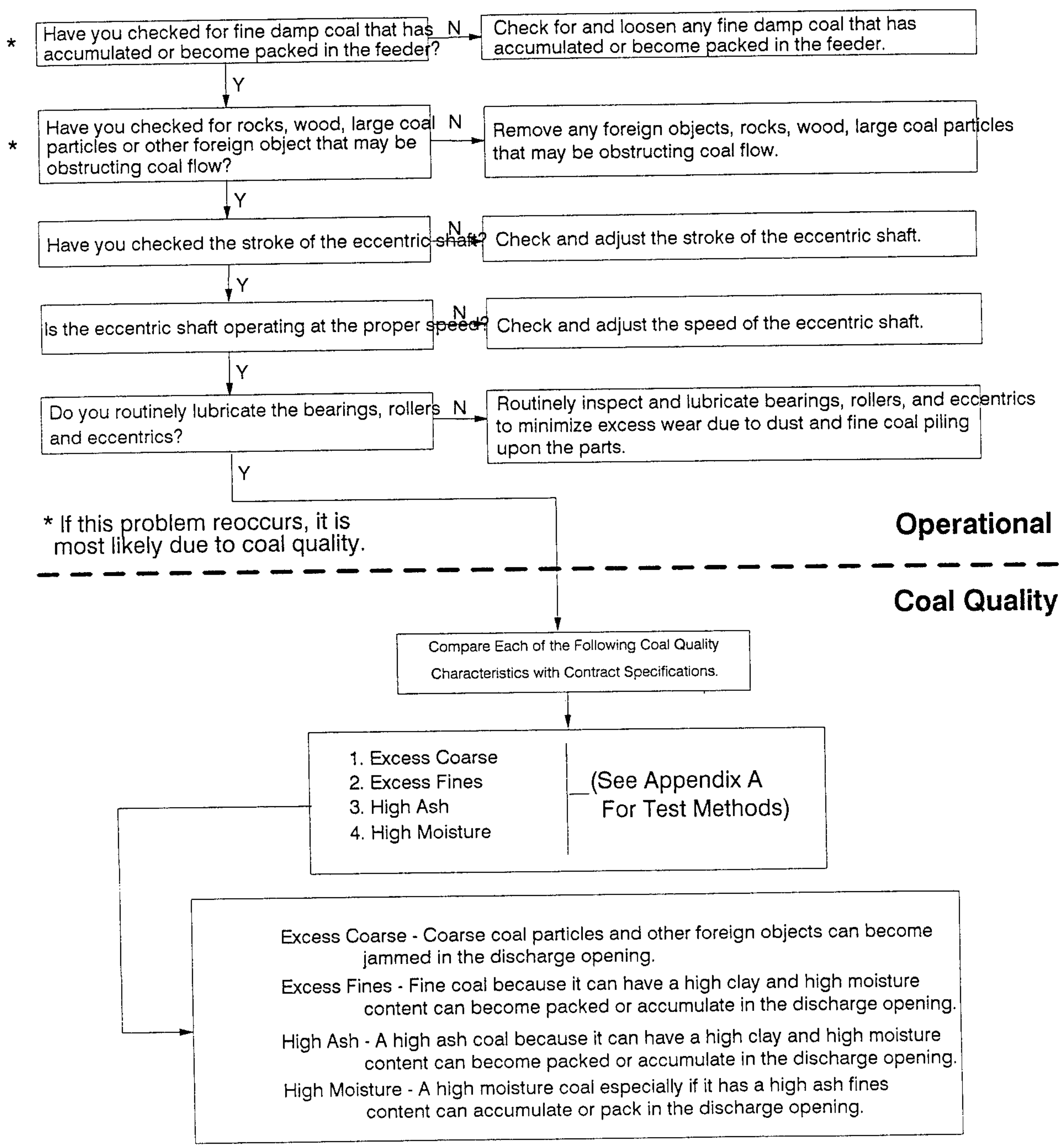


FIG6-21n/1

FIGURE 6-22: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Feed Conveyor (Belt Conveyor)

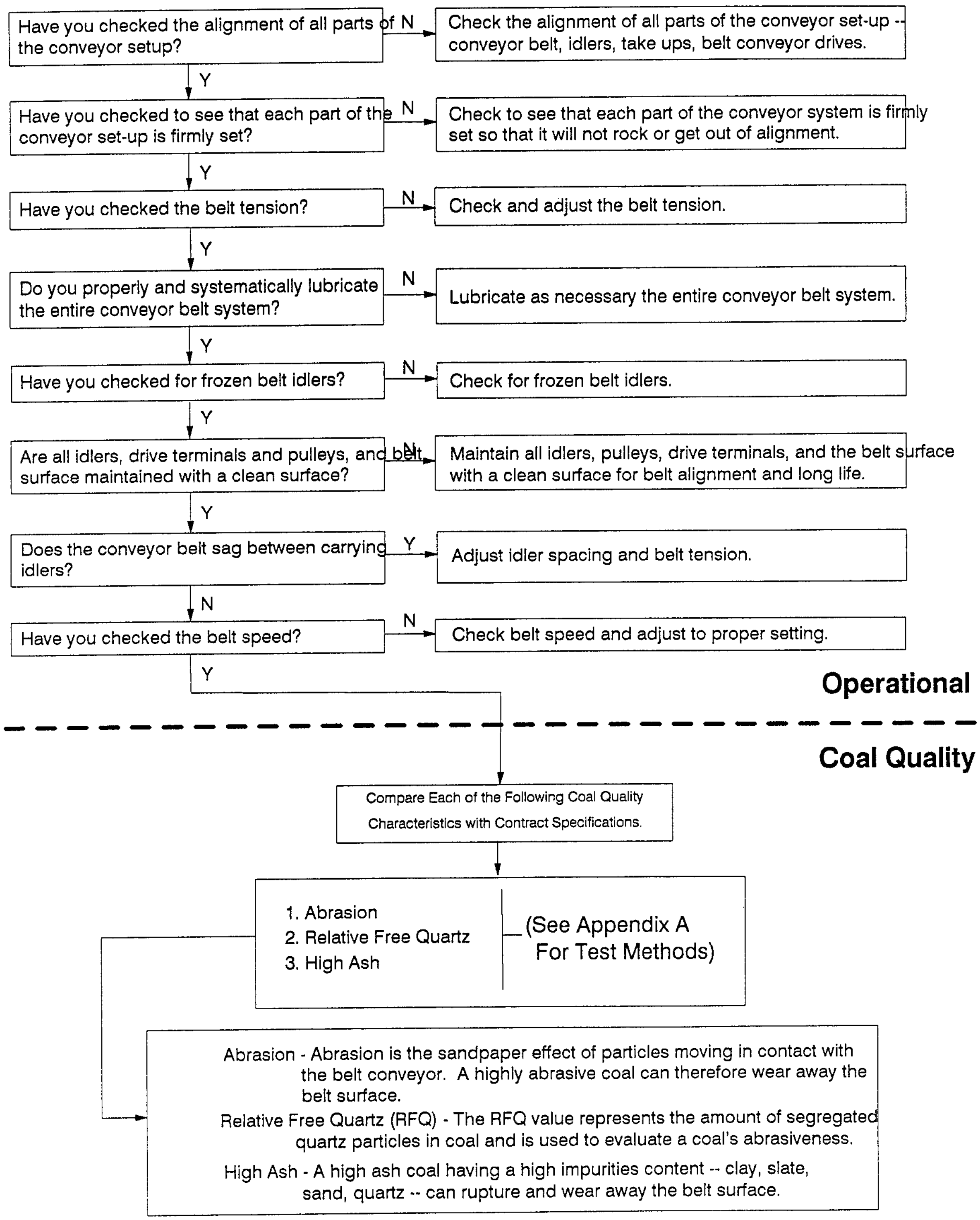


FIG6-22n/1

FIGURE 6-23: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor
(Belt Conveyor)

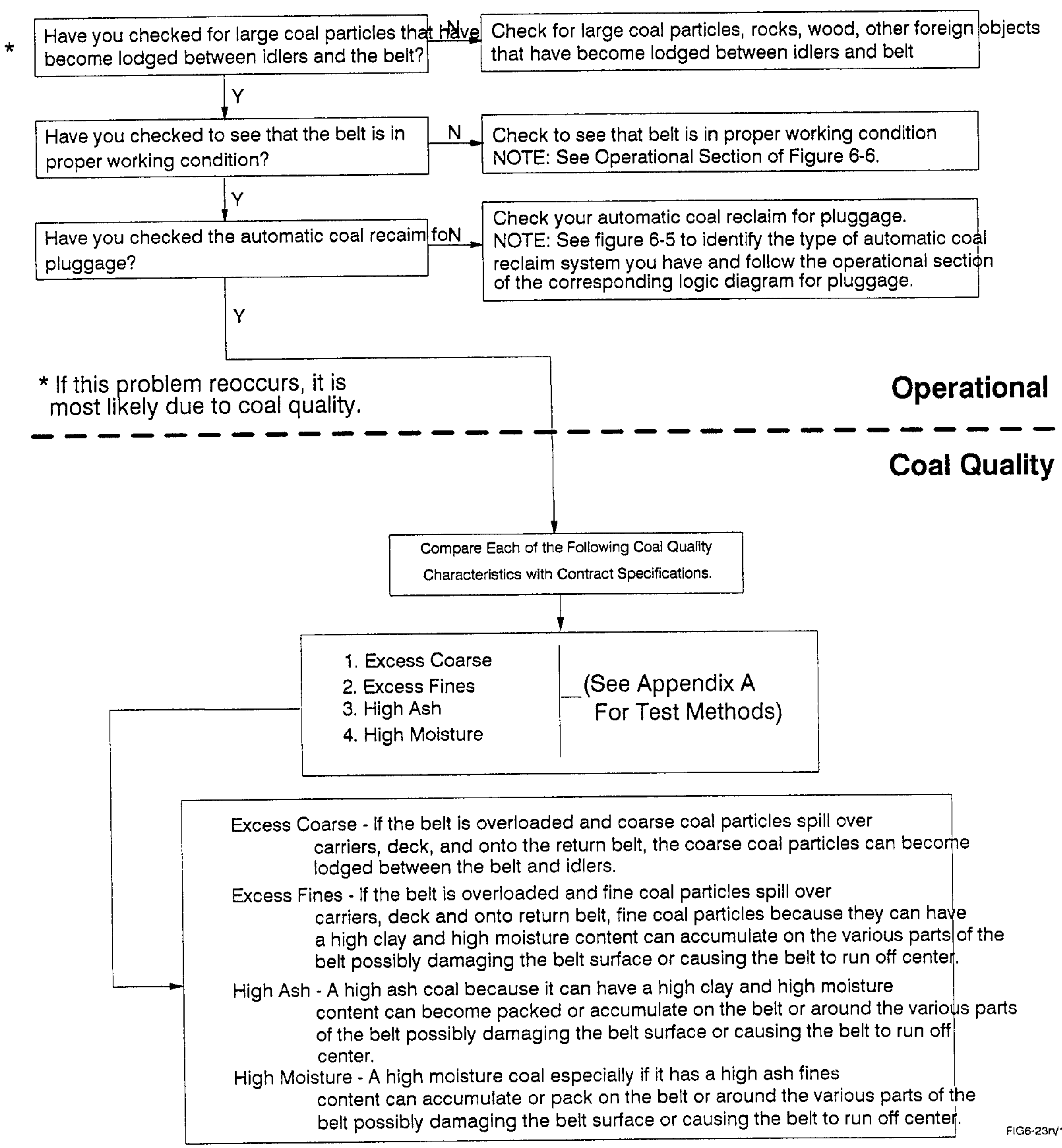


FIGURE 6-24: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Belt Conveyor)

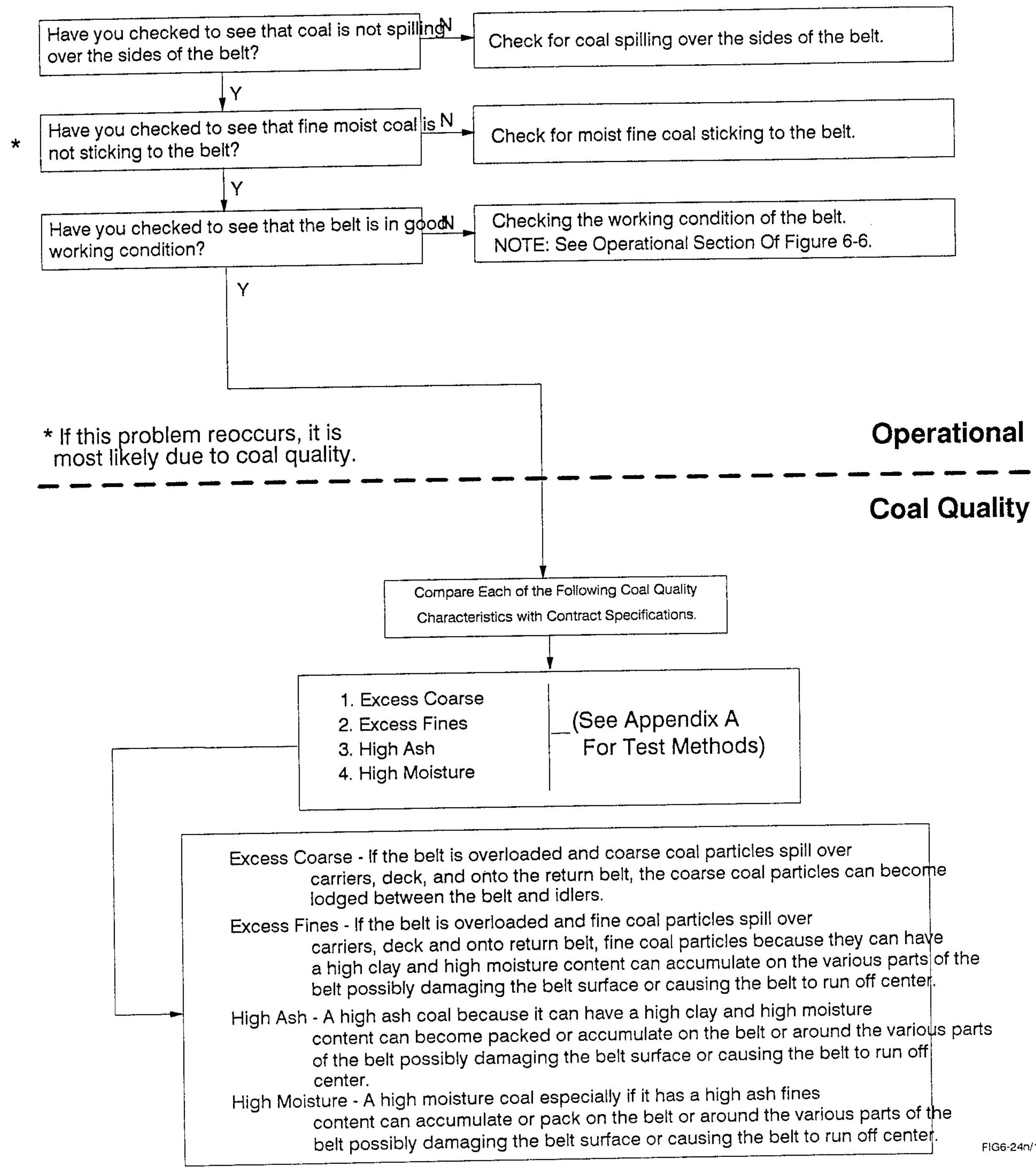


FIG6-24n/1

FIGURE 6-25: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Belt Conveyor)

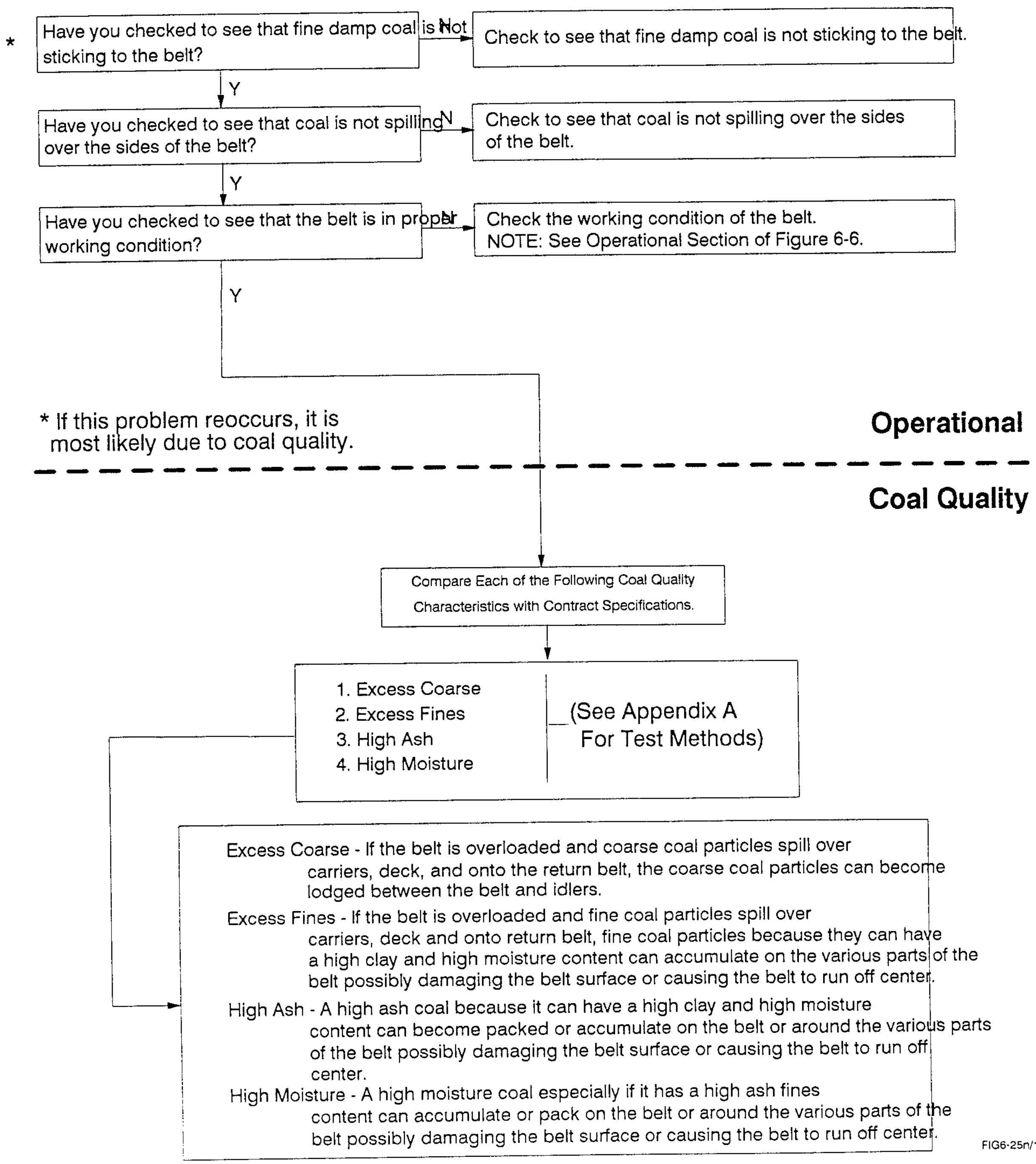


FIGURE 6-26: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor

(Screw Conveyor)

* Have you checked to see that fine damp coal has not become packed in between the screw and the casing?

N → Check to see that fine damp coal has not become packed in between the screw and the casing.

Y ↓

Have you checked the screw speed?

N → Check and adjust the speed at which the screw is turning.

Y ↓

Do you routinely inspect and maintain the screw to keep it in proper working condition?

No → Perform routine inspections and maintenance to ensure that the screw conveyor operates properly.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Abrasion
2. Relative Free Quartz
3. High Ash

(See Appendix A For Test Methods)

Abrasion - Abrasion is the sandpaper effect of particles moving in contact with the screw conveyor. A highly abrasive coal can therefore wear away the metal surfaces of the screw conveyor.

Relative Free Quartz (RFQ) - The RFQ value represents the amount of segregated quartz particles in coal and is used to evaluate a coal's abrasiveness.

High Ash - A high ash coal having a high impurities content -- clay, slate, sand, quartz -- can wear away the metal surface of the screw conveyor.

FIG6-26n/1

FIGURE 6-27: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Screw Conveyor)

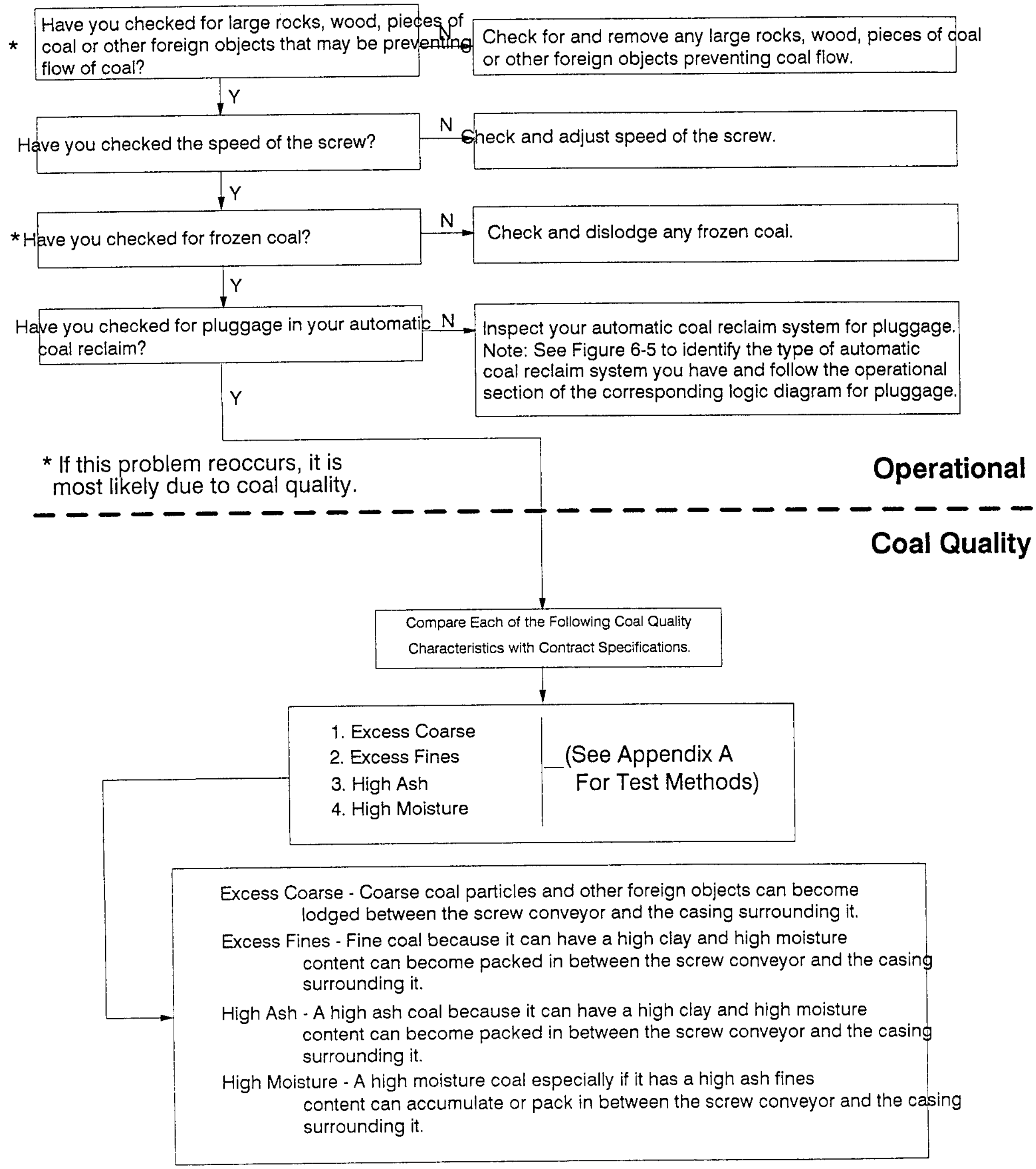


FIG6-27n/1

FIGURE 6-28: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Screw Conveyor)

* Have you checked to see that fine damp coal is not packed in between the screw and the casing?
- N → Check to see that fine damp coal has not become packed in between the screw and the casing.
- Y ↓

Have you checked the speed at which the screw is operating?
- N → Check the speed at which the screw is operating and adjust to the proper setting.
- Y ↓

* Have you checked for frozen coal?
- N → Check for and dislodge frozen coal.
- Y ↓

Have you checked the coal feed rate to the screw conveyor?
- N → Check and adjust coal feed rate from you automatic coal reclaim.
- Y ↓

Do you routinely inspect and maintain the screw feeder to ensure its proper working condition?
- N → Perform routine inspections and maintenance to ensure that the screw conveyor operators properly.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can become lodged between the screw conveyor and the casing surrounding it.

Excess Fines - Fine coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Ash - A high ash coal because it can have a high clay and high moisture content can become packed in between the screw conveyor and the casing surrounding it.

High Moisture - A high moisture coal especially if it has a high ash fines content can accumulate or pack in between the screw conveyor and the casing surrounding it.

FIG6-28n/1

FIGURE 6-29: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Screw Conveyor)

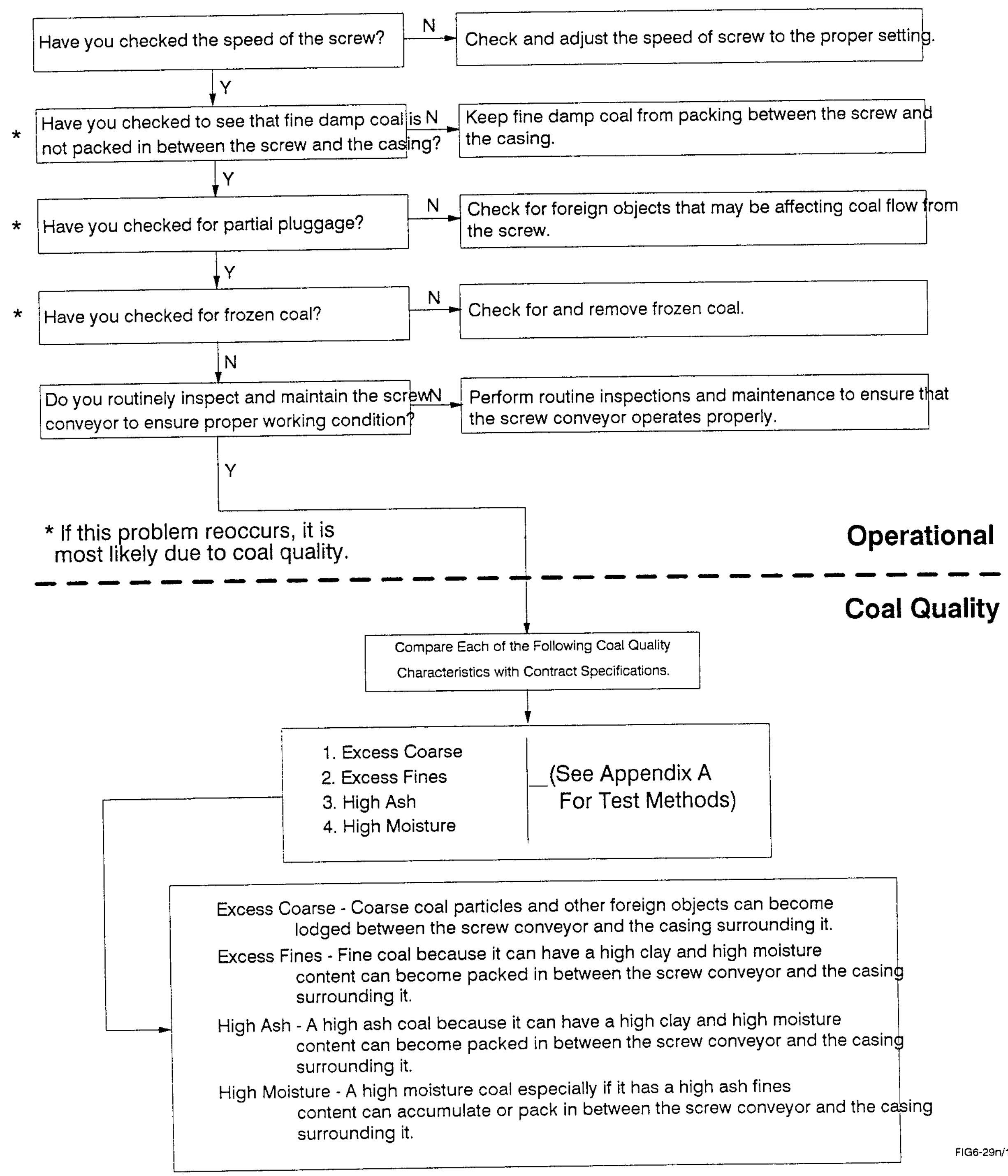


FIG6-29n/1

FIGURE 6-30: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear In The Coal Feed Conveyor (Bucket Conveyor)

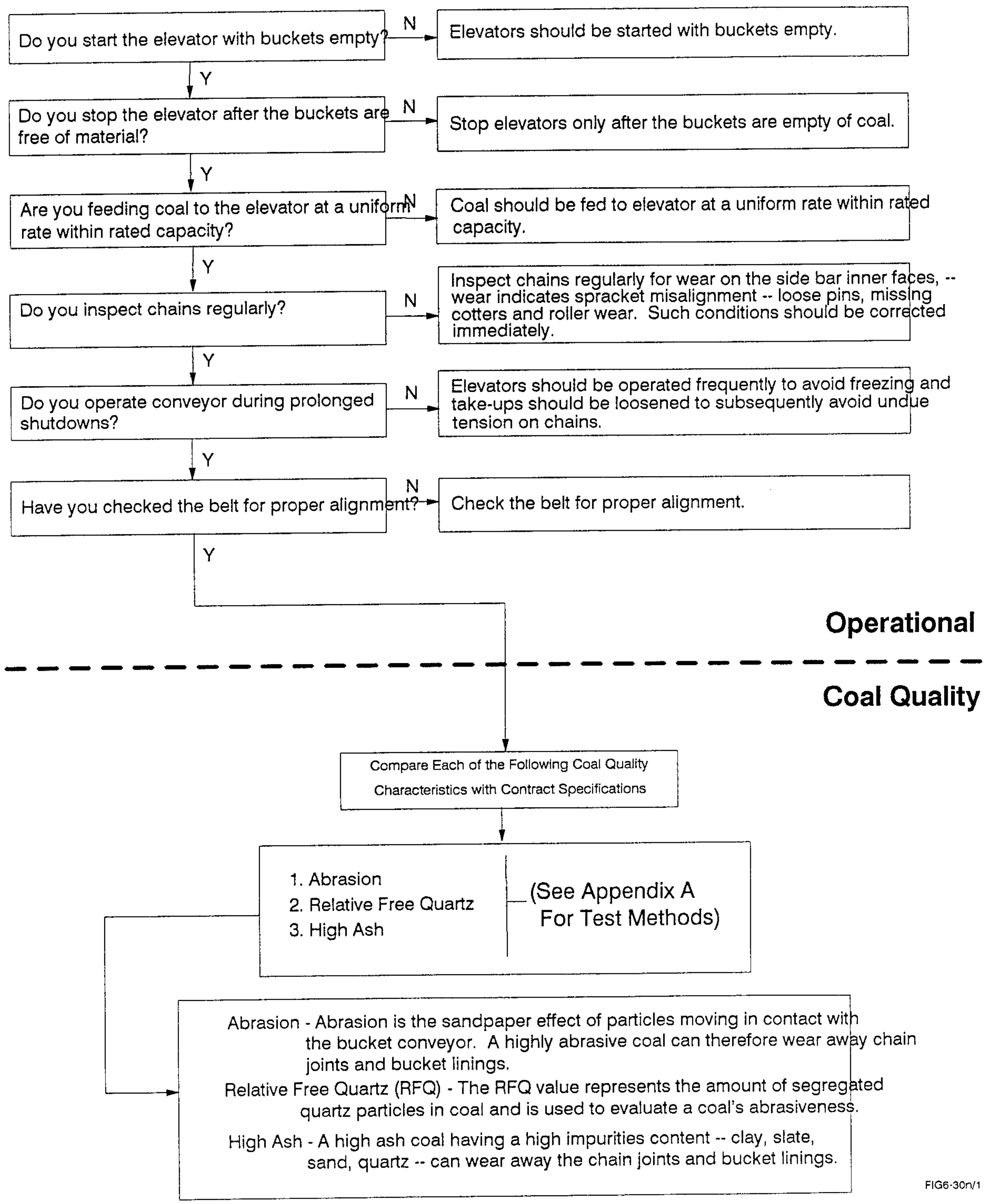


FIGURE 6-31: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Bucket Conveyor)

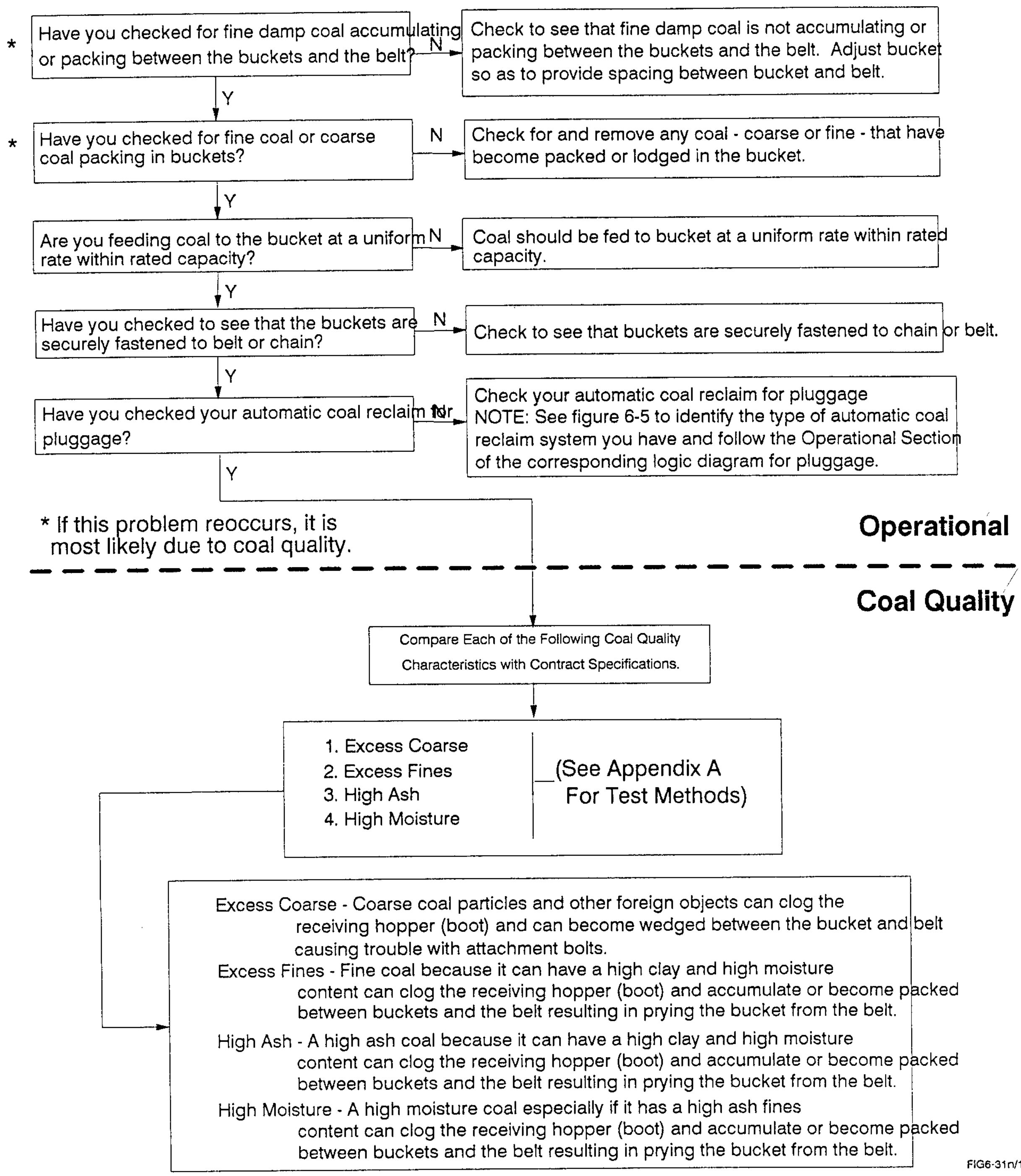


FIG6-31n/1

FIGURE 6-32: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity Of The Coal Feed Conveyor (Bucket Conveyor)

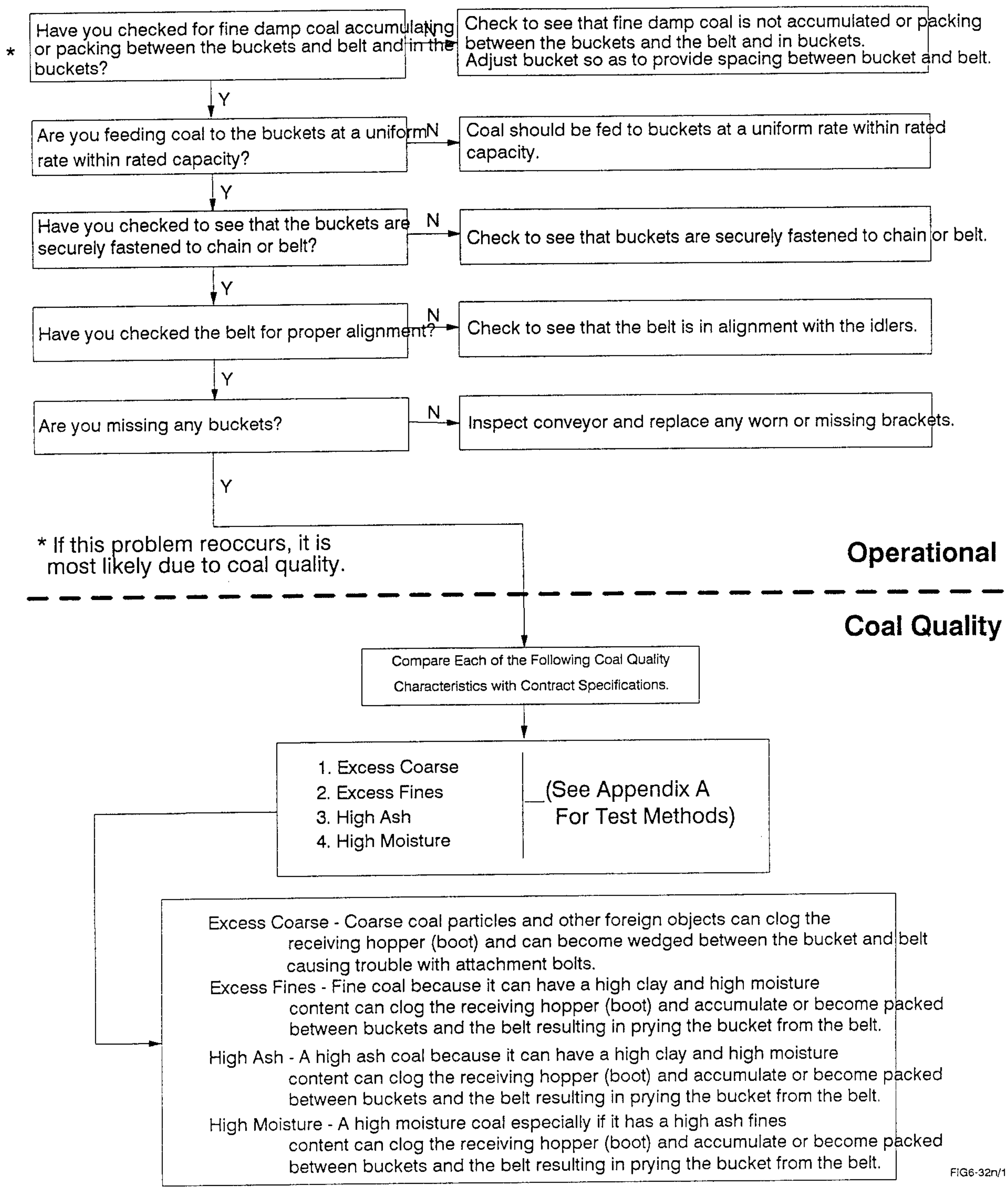


FIGURE 6-33: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

Erratic Feeding From The Coal Feed Conveyor (Bucket Conveyor)

* Have you checked for fine damp coal accumulating or packing between the buckets and the belt?

N → Check to see that fine damp coal is not accumulating or packing between the belt and the buckets. Adjust buckets to provide spacing between the bucket and the belt.

Y ↓

* Have you checked for fine or coarse coal packed in the buckets?

N → Check for fine or coarse material that may be packed in the buckets.

Y ↓

Are you feeding coal to the buckets at a uniform rate within rated capacity?

N → Coal should be fed to the buckets at a uniform rate within rated capacity.

Y ↓

Have you checked to see that the buckets are securely fastened?

N → Check to see that all buckets are secure.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become wedged between the bucket and belt causing trouble with attachment bolts.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between buckets and the belt resulting in prying the bucket from the belt.

FIG6-33n/1

FIGURE 6-34: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Wear Of The Coal Feed Conveyor

(Redler Conveyor)

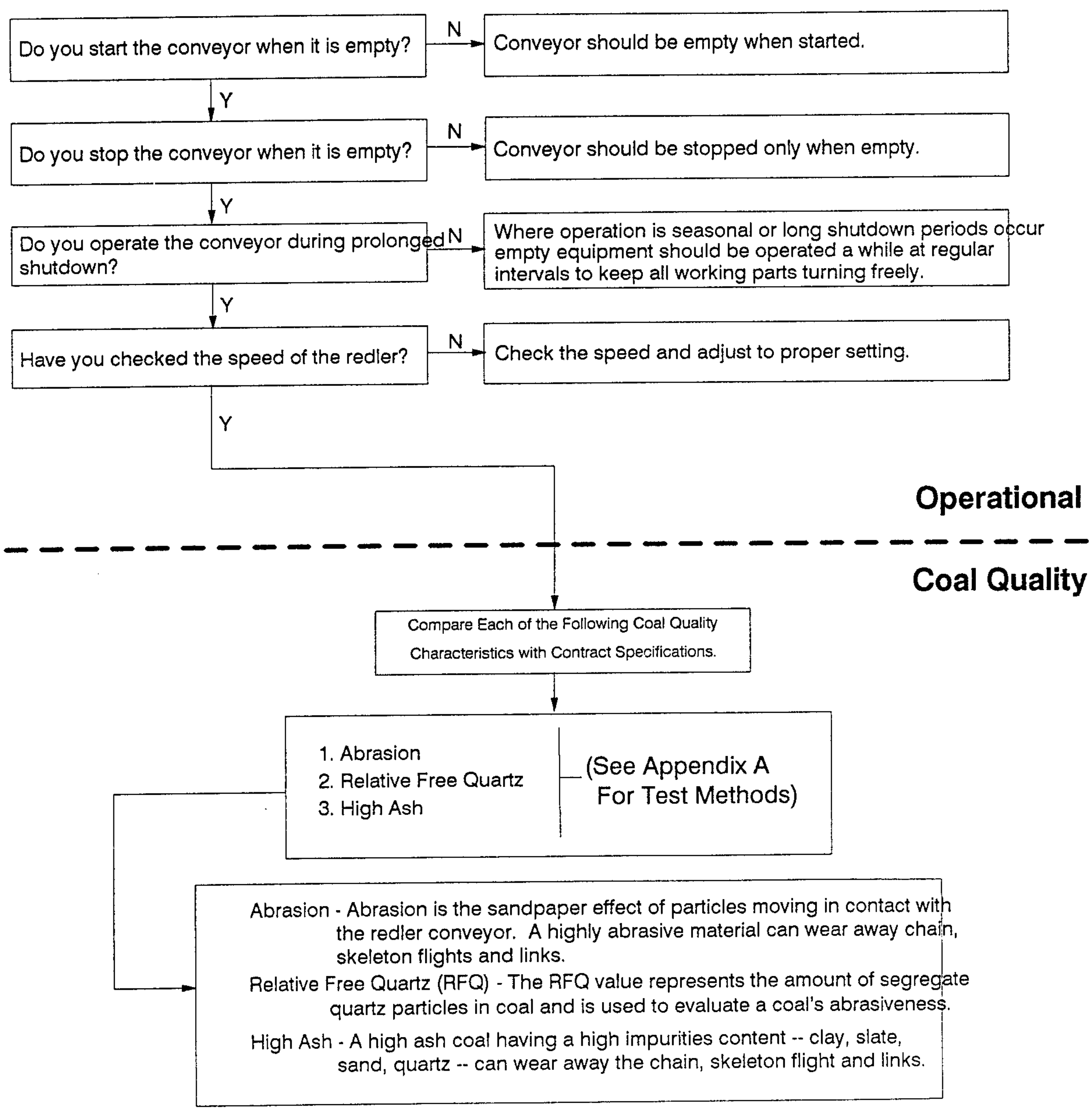


FIG6-34n/1

FIGURE 6-35: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor (Redler Conveyor)

* Have you checked to see that fine damp coal has not become packed between the skeleton flights?
- N → Check to see that fine damp coal has not become packed between the skeleton flights.
- Y ↓

Have you checked to see that coal is being fed at a uniform rate within rated capacity?
- N → Check to see that coal is being fed at a uniform rate within rated capacity.
- Y ↓

* Have you checked to see that coarse material -- rocks, wood, -- have not become lodged between the duct and the skeleton flight chain?
- N → Check to see that coarse material -- rocks, wood, etc.-- have not become lodged between the duct or tube and the skeleton flight chain.
- Y ↓

Have you checked your automatic coal reclaim for pluggage?
- N → Check your automatic coal reclaim for pluggage. NOTE: See figure 6-5 to identify the type of automatic coal reclaim system you have and follow the Operational Section of the corresponding logic diagram for pluggage.
- Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG6-35n/1

FIGURE 6-36: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Coal Feed Conveyor (Redler Conveyor)

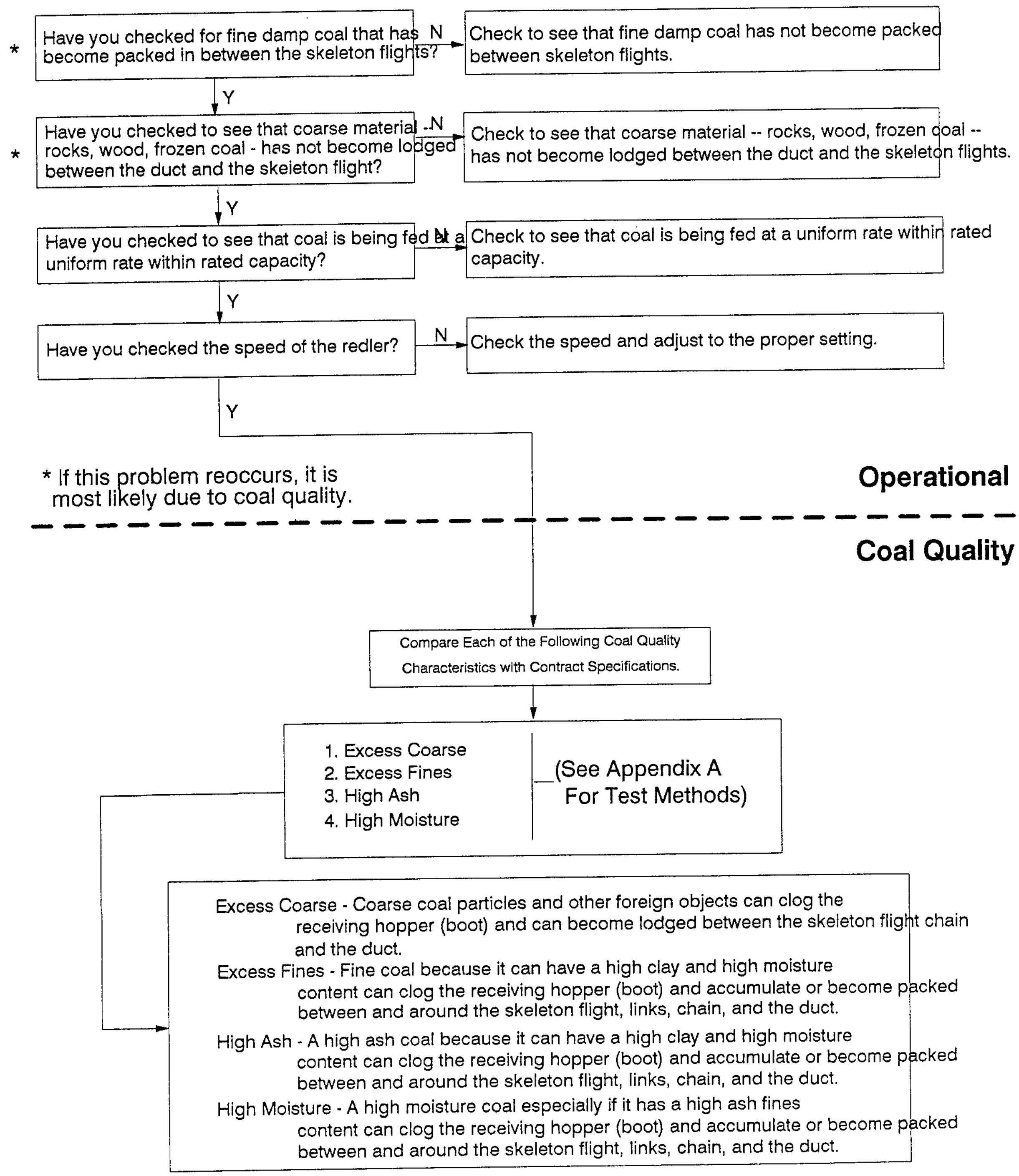


FIG6-36n/1

FIGURE 6-37: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Redler Conveyor)

* Have you checked that fine damp coal has not become packed between the skeleton flights?

N → Check to see that fine damp coal has not become packed between skeleton flights.

Y ↓

* Have you checked to see that rocks, wood, large coal particles have not become lodged between the duct and the skeleton flights?

N → Check to see that rocks, wood, large coal particles have not become lodged between duct and skeleton flights.

Y ↓

Have you checked to see that the coal is being fed at a uniform rate within rated capacity?

N → Check to see that coal is being fed at a uniform rate within rated capacity.

Y ↓

* If this problem reoccurs, it is most likely due to coal quality.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Excess Coarse
2. Excess Fines
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Excess Coarse - Coarse coal particles and other foreign objects can clog the receiving hopper (boot) and can become lodged between the skeleton flight chain and the duct.

Excess Fines - Fine coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Ash - A high ash coal because it can have a high clay and high moisture content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

High Moisture - A high moisture coal especially if it has a high ash fines content can clog the receiving hopper (boot) and accumulate or become packed between and around the skeleton flight, links, chain, and the duct.

FIG6-37n/1

FIGURE 6-38: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feed Conveyor

(Chute)

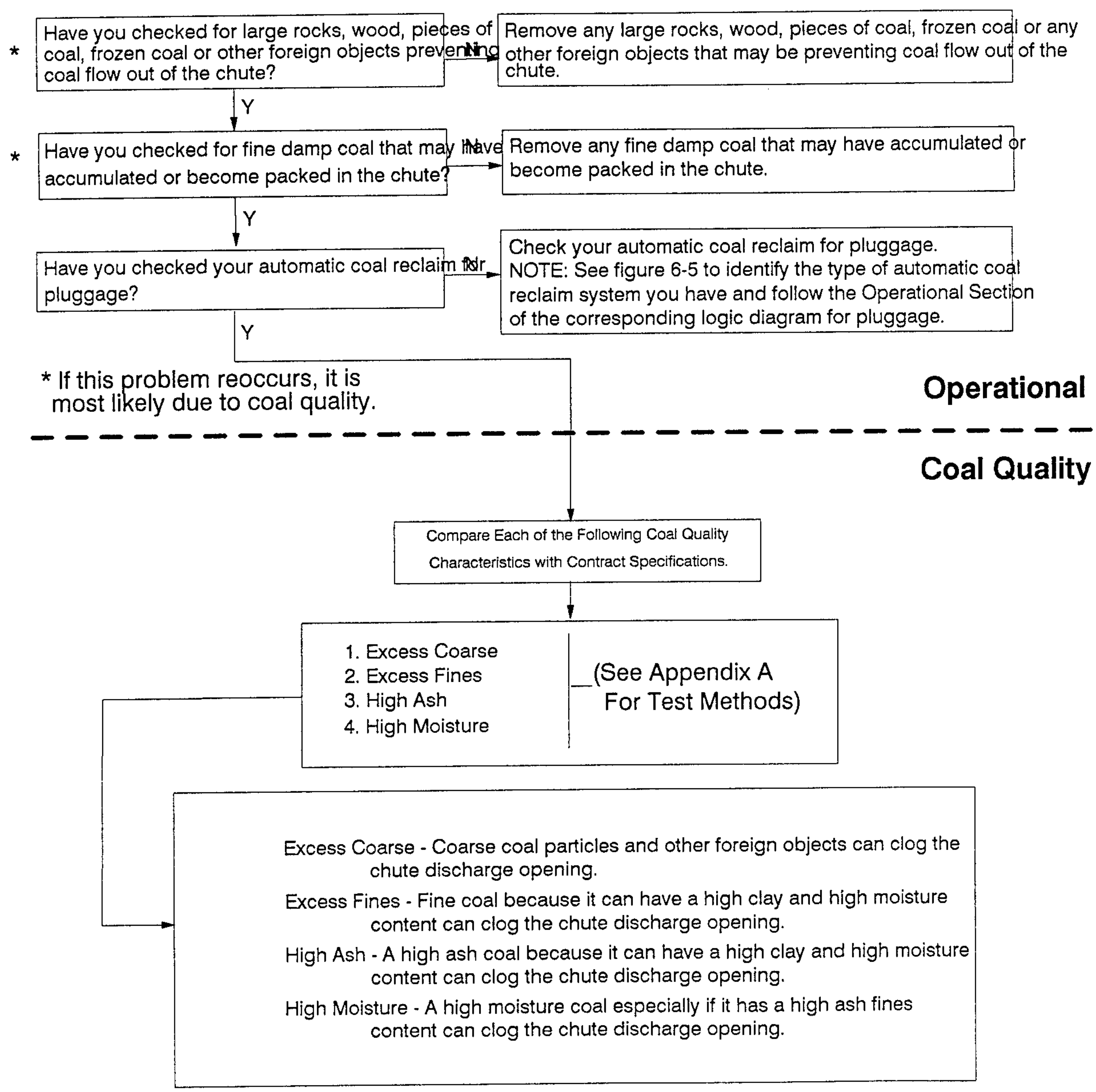


FIG6-38n/1

FIGURE 6-39: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In The Coal Feed Conveyor (Chute)

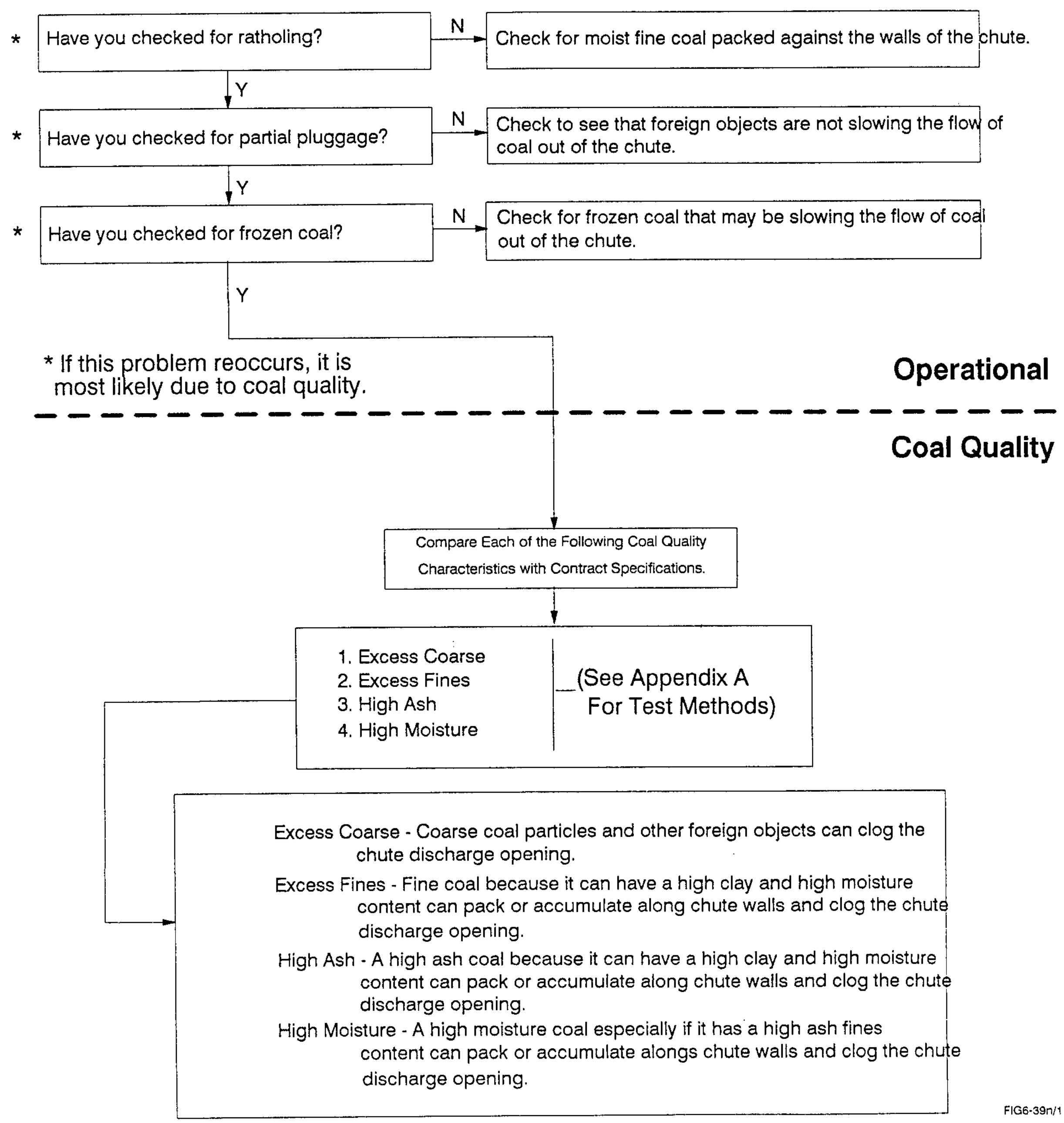


FIG6-39n/1

FIGURE 6-40: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feed Conveyor (Chute)

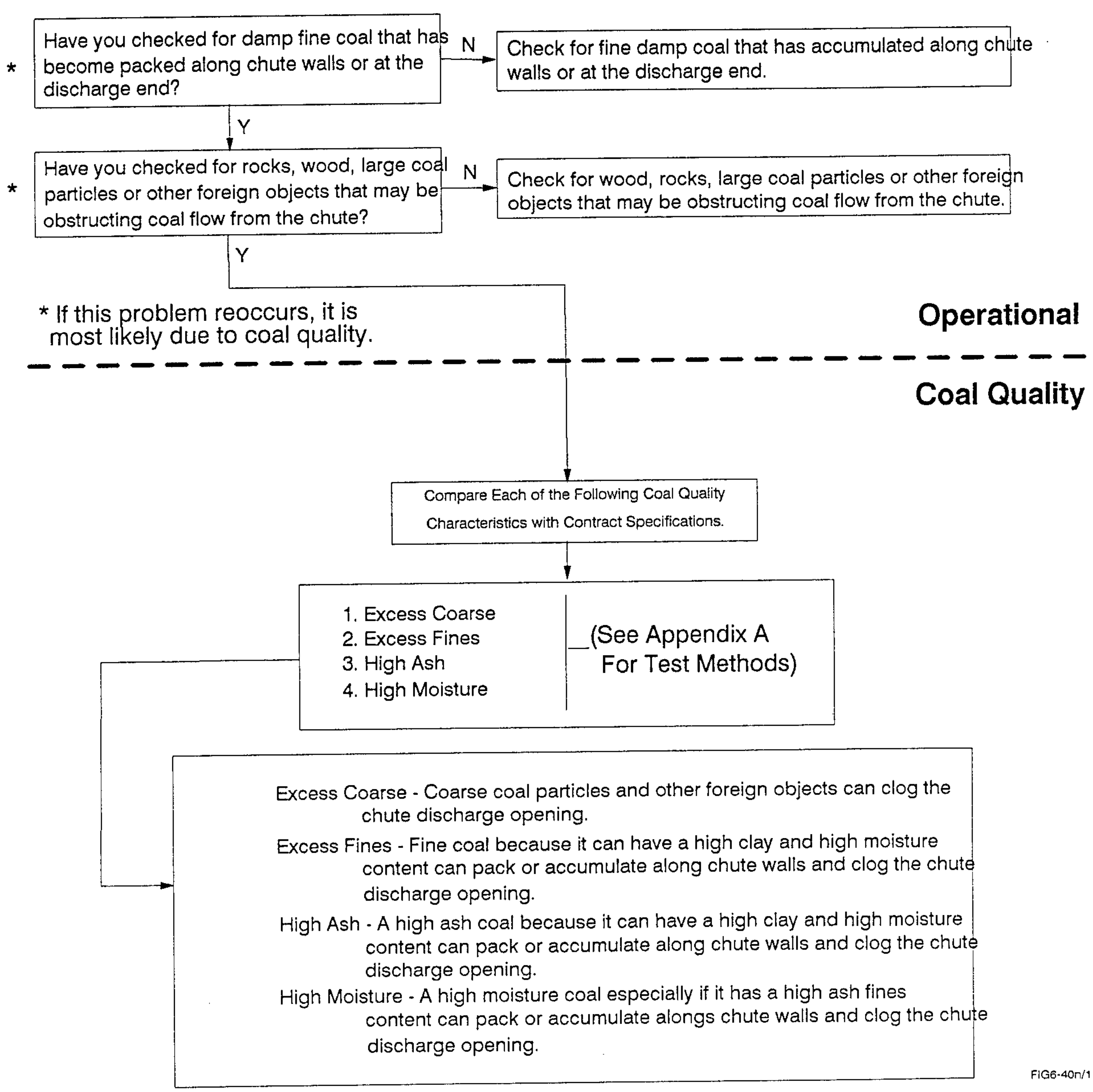


FIG6-40n/1

FIGURE 6-41: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Feeders

(Chute)

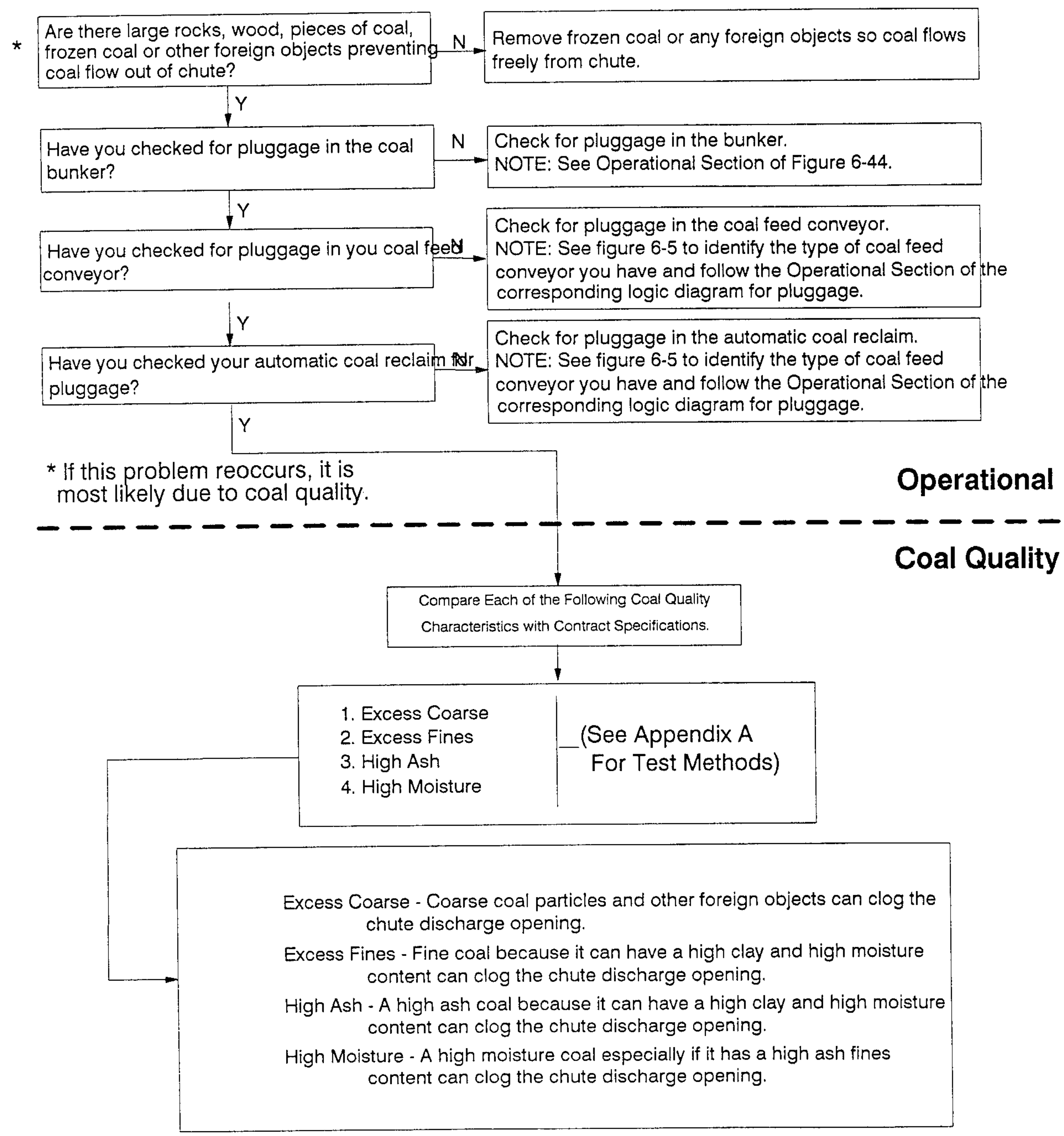


FIG6-41n/2

FIGURE 6-42: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity In the Coal Feeder

(Chutes)

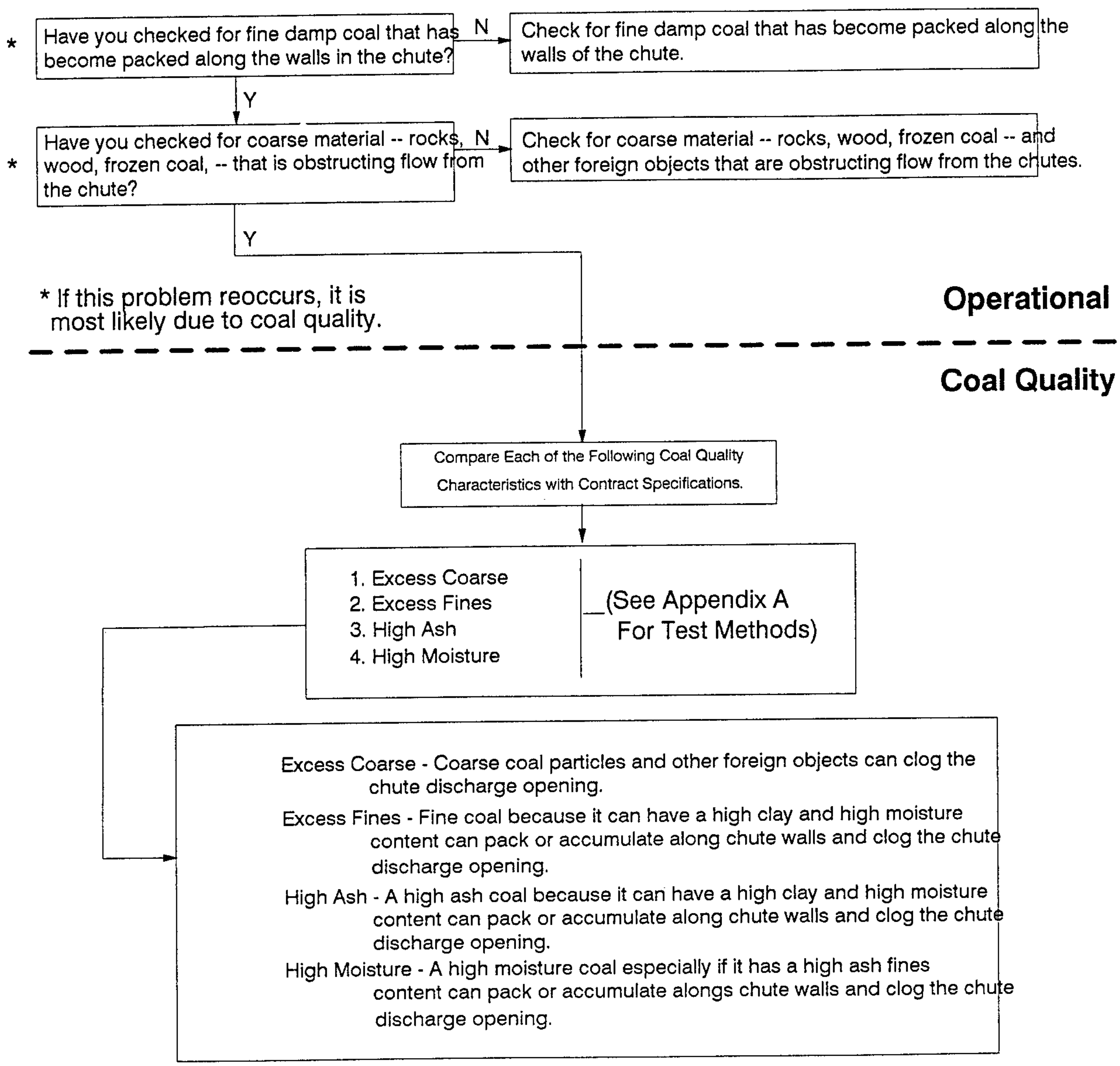


FIG6-42n/2

FIGURE 6-43: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Feeder
(Chutes)

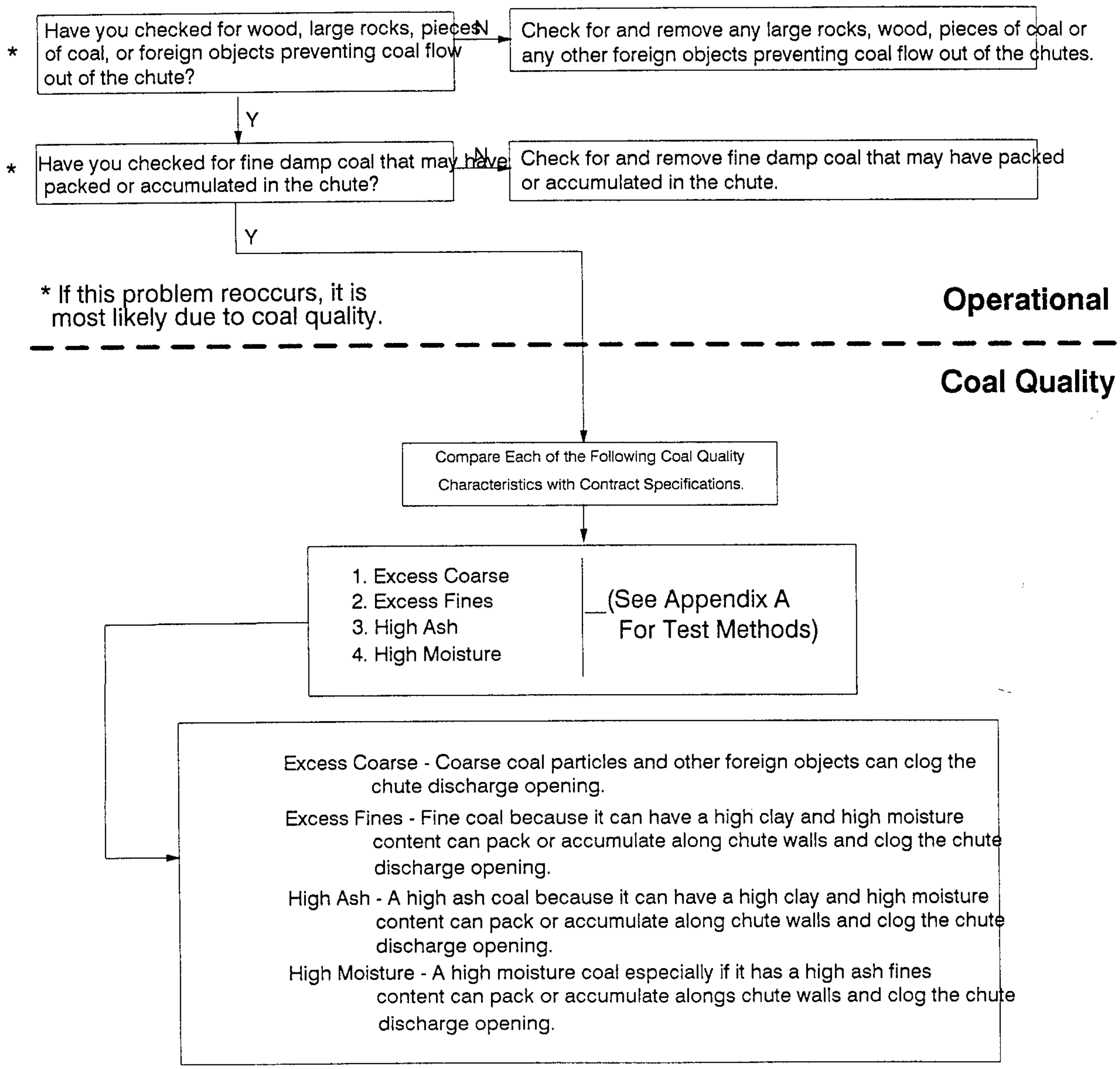


FIG6-43n/2

FIGURE 6-45: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity In The Bunker

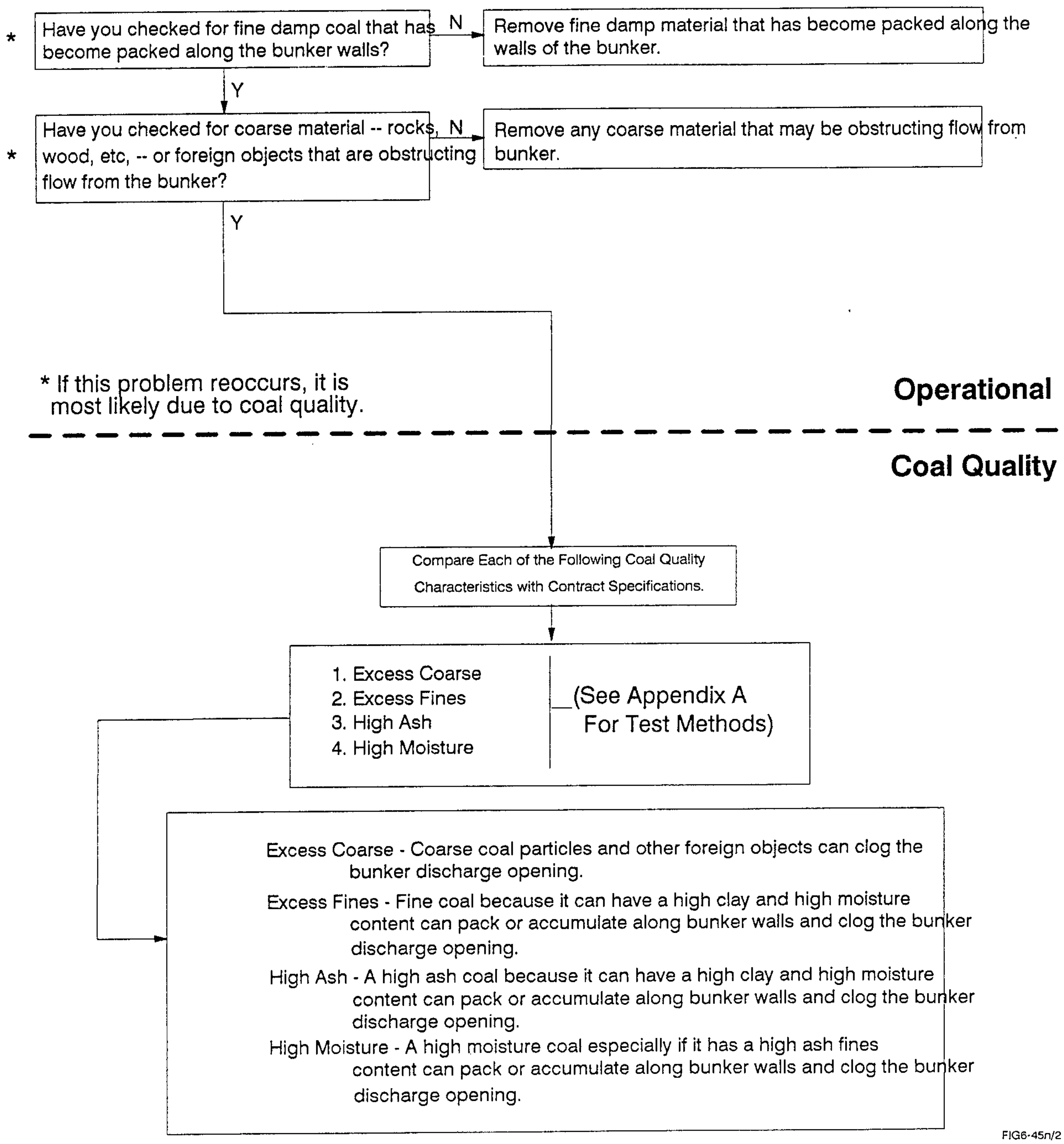


FIG6-45n/2

FIGURE 6-46: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Bunker

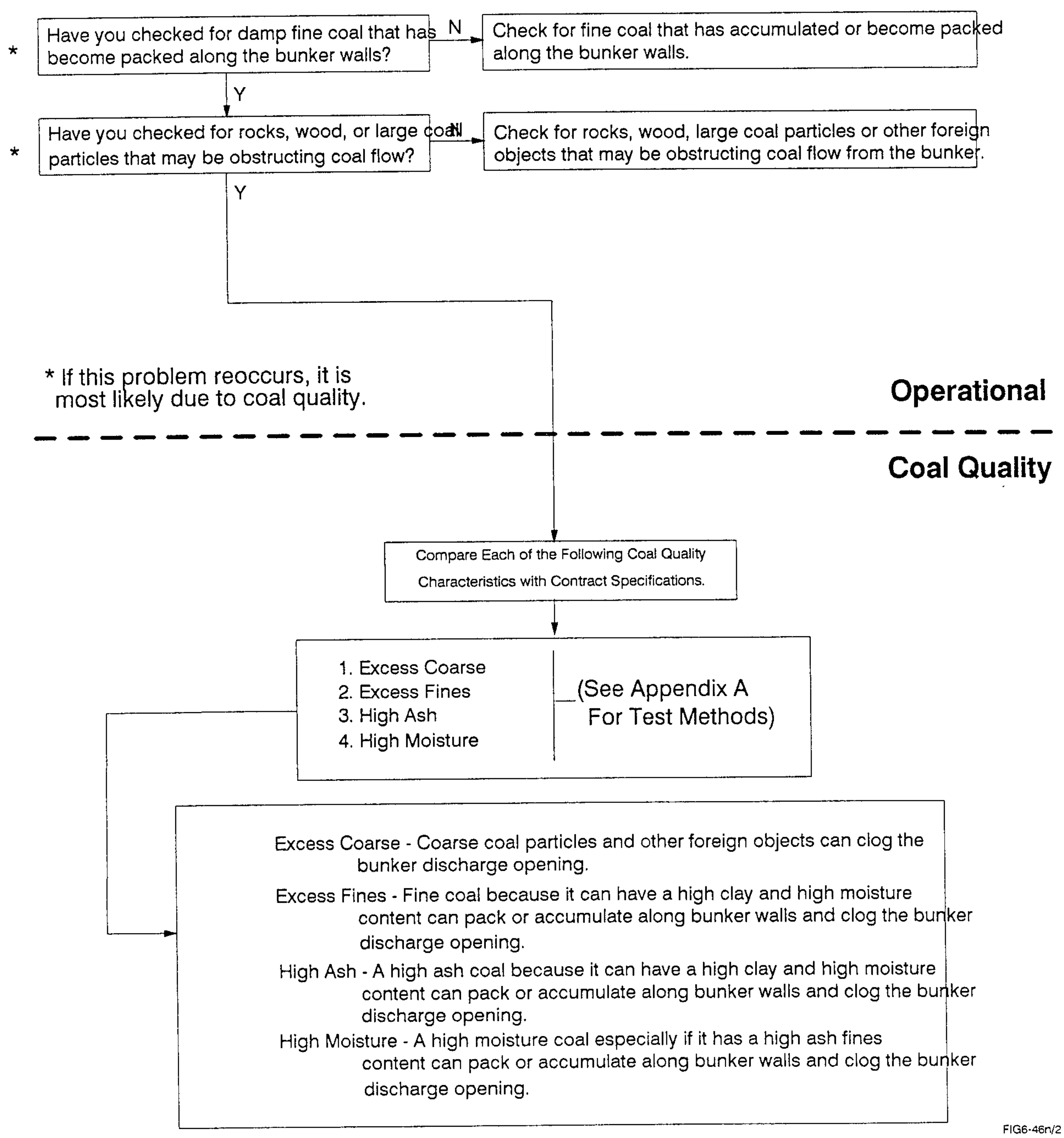


FIG6-46n/2

FIGURE 6-47: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage In The Coal Hopper

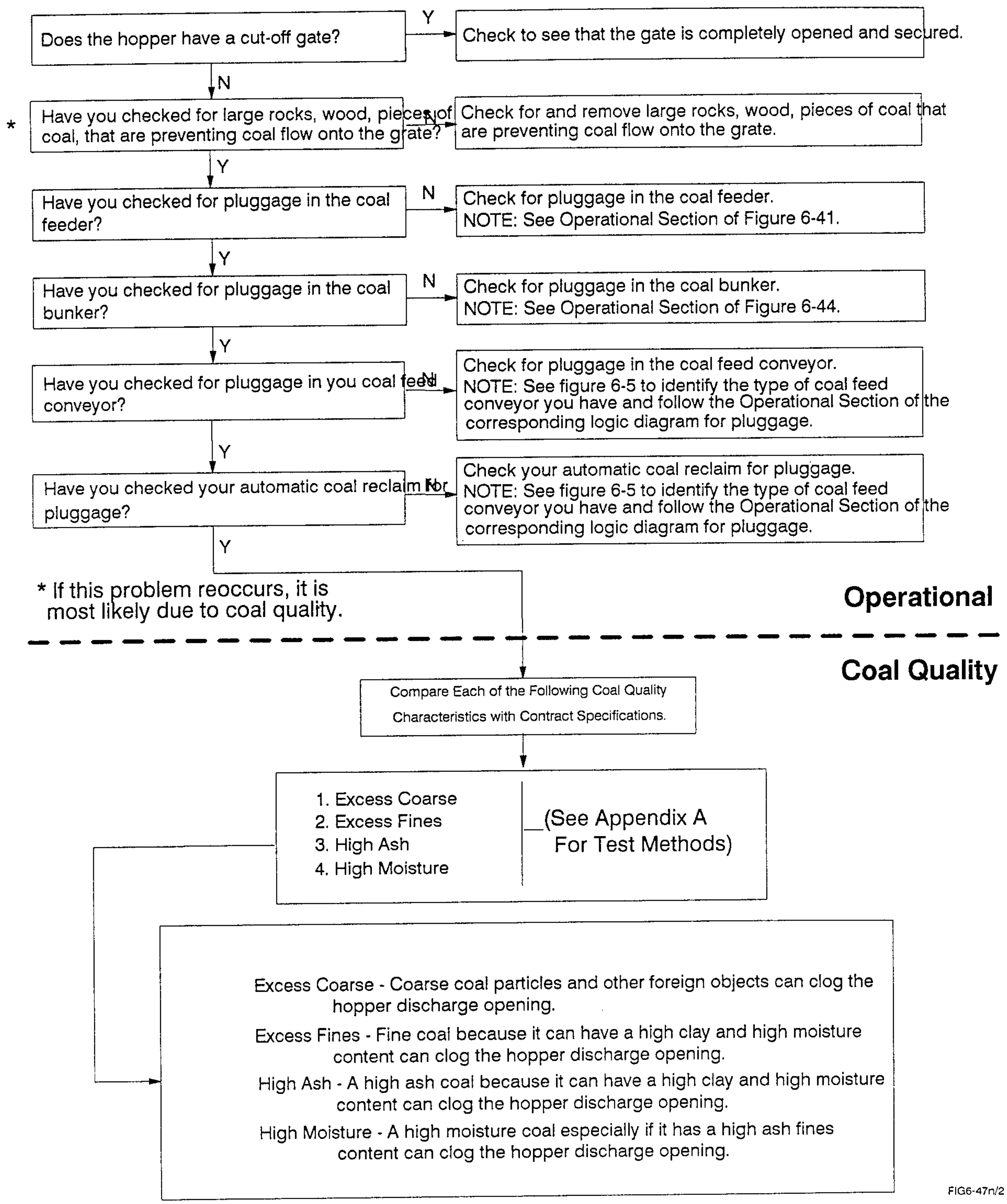


FIGURE 6-48: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

Insufficient Capacity In The Coal Hopper

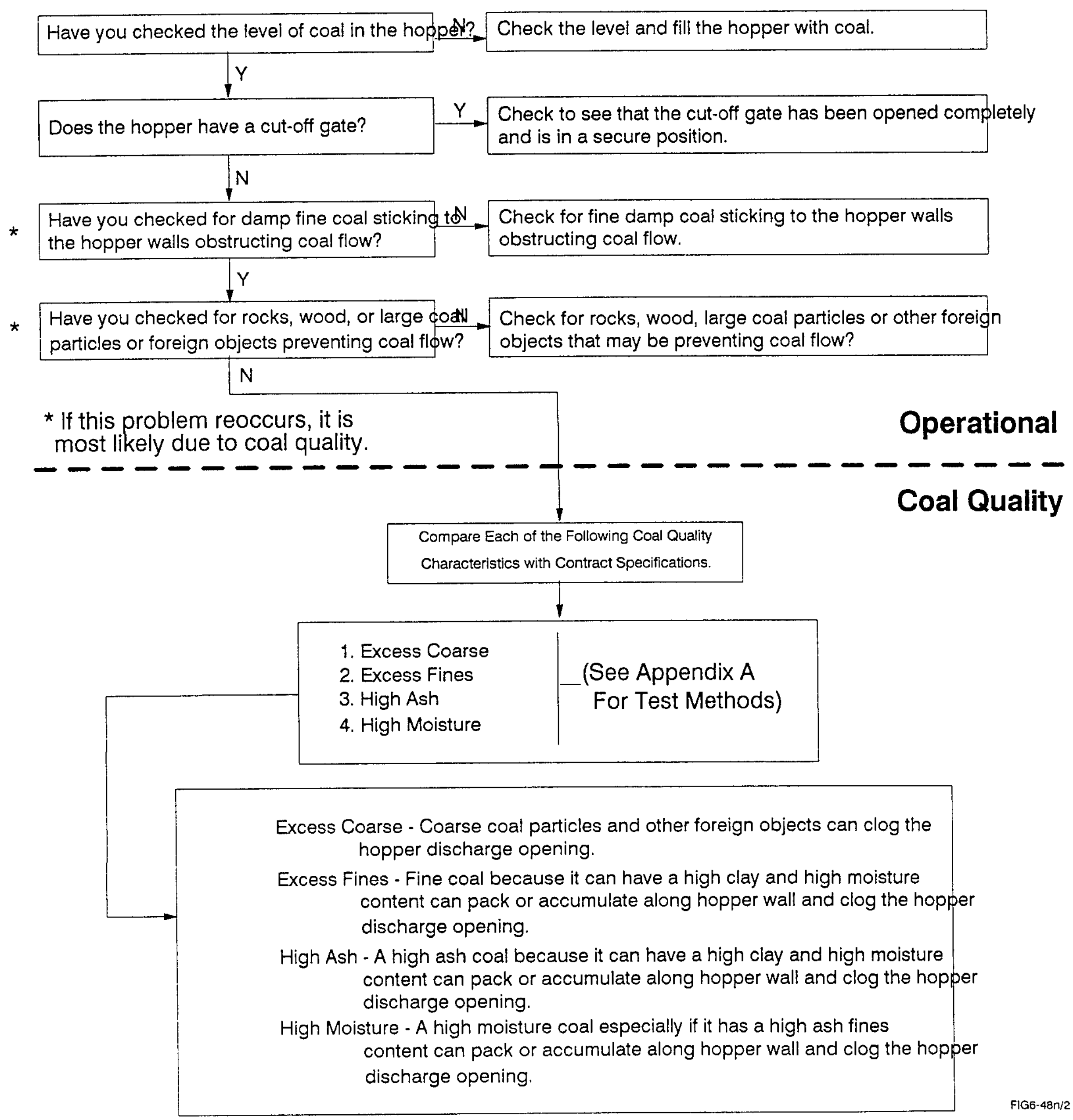


FIG6-48n/2

FIGURE 6-49: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Coal Hopper

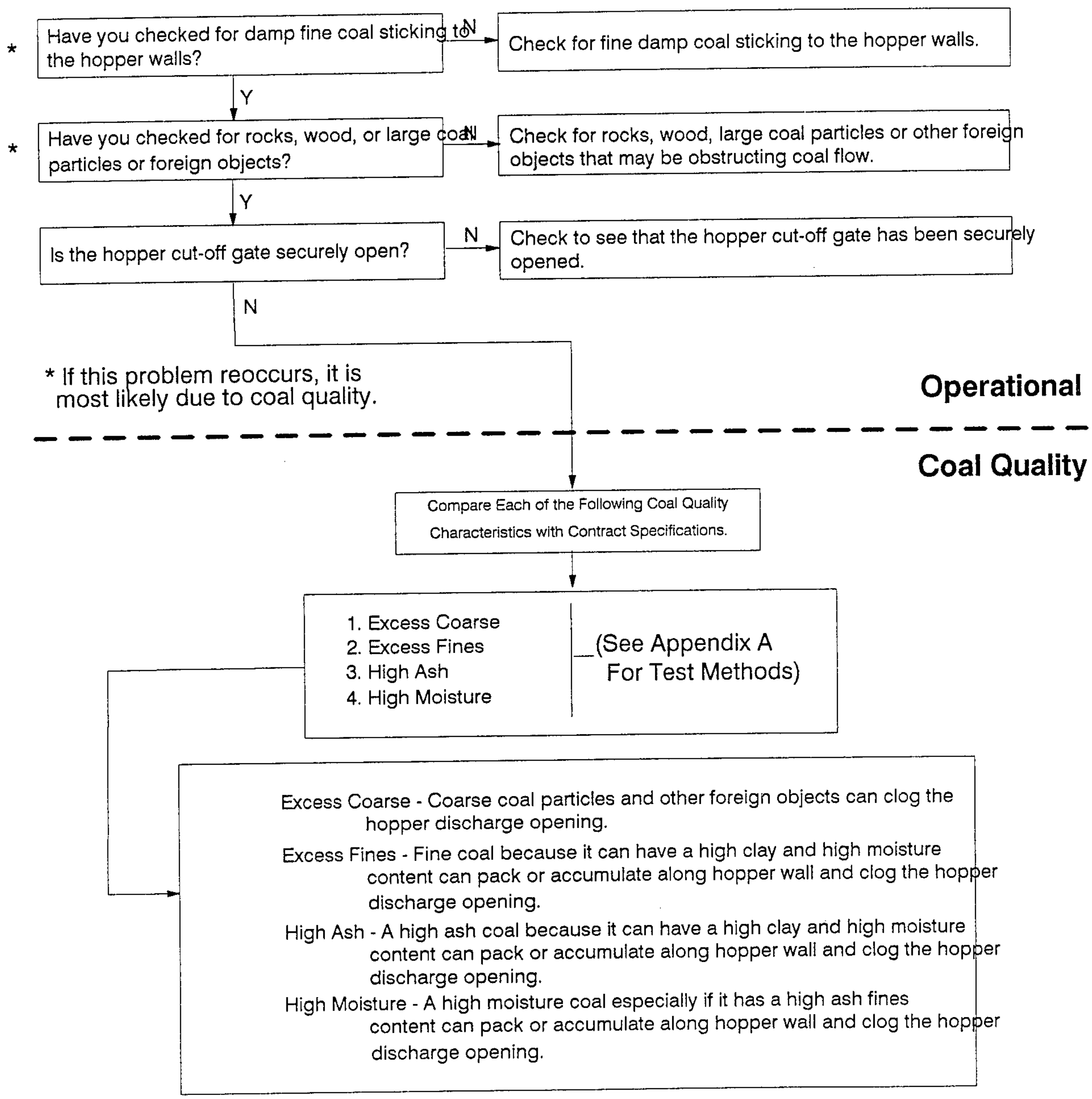


FIG6-49n/2

FIGURE 6-50: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Pluggage In The Limestone Bunker/Hopper

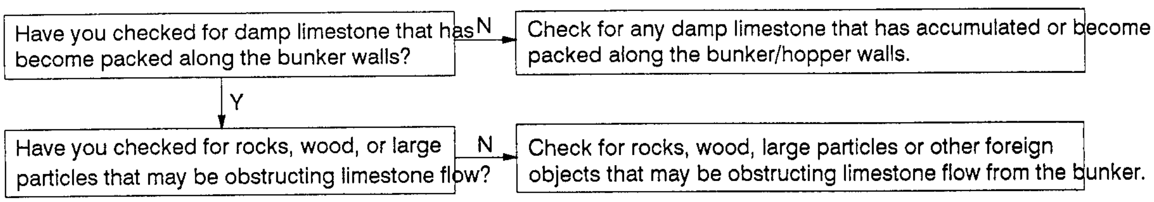


FIG6-50n/2

FIGURE 6-51: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity From The Limestone Bunker/Hopper

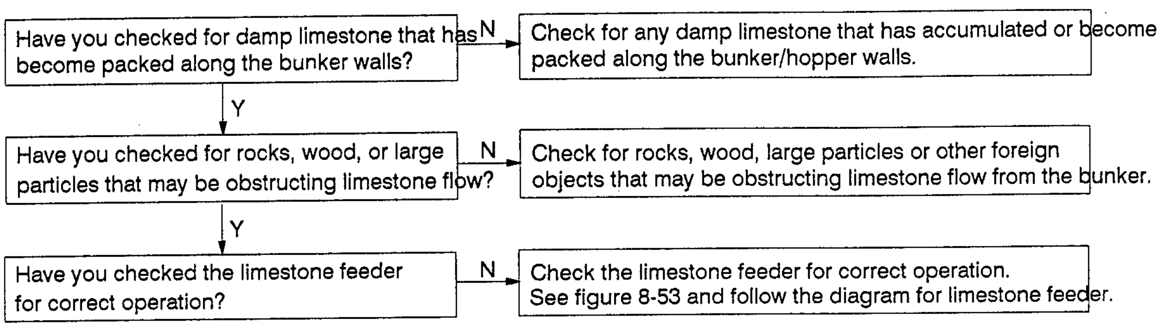


FIG6-50n/2

FIGURE 6-52: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erratic Feeding From The Limestone Bunker/Hopper

Have you checked for damp limestone that has become packed along the bunker walls?
- N → Check for any damp limestone that has accumulated or become packed along the bunker/hopper walls.
- Y ↓

Have you checked for rocks, wood, or large particles that may be obstructing limestone flow?
- N → Check for rocks, wood, large particles or other foreign objects that may be obstructing limestone flow from the bunker.
- Y ↓

Have you checked the limestone feeder for correct operation?
- N → Check the limestone feeder for correct operation. See figure 6-53 and follow the diagram for limestone feeder.

FIG6-52n/2

FIGURE 6-53: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Pluggage Of The Limestone Feeder

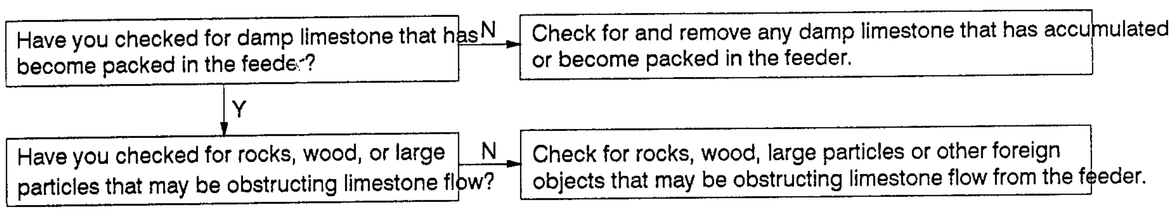
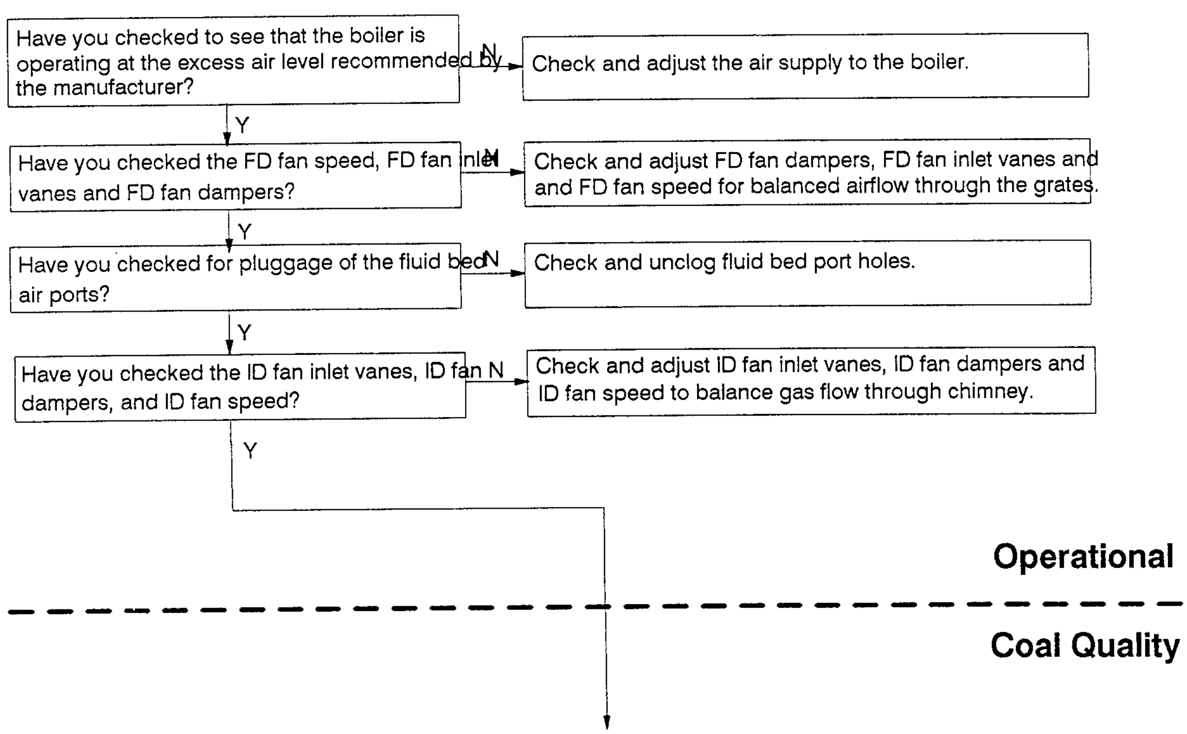


FIG6-53n/2

FIGURE 6-54: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load

(Boiler)



See next page for Coal Quality Section.

FIG6-54n/2

RE 6-54 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Insufficient Capacity And Inability To Meet Load

See operational section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. Low Heating Value
2. Low Volatile Matter
3. High Fixed Carbon
4. High ASH
5. Excess Coarse
6. Excess Fine
7. Low Moisture

(See Appendix A For Test Methods)

Low Heating Value - If the coal is lower in heating value more will need to be burned to meet demand which can lead to increase operation and maintenance of storage and handling equipment.

Low Volatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace high combustible losses can occur.

High Ash - If excessive ash particles become thick on the fluid bed grate to seriously restrict air flow through the grate and fuel bed making it difficult for air flow.

Excess Coarse - Coarse coal tends to segregate in coal conveying equipment and hoppers.

Excess Fines - Too many fines can cake (agglomerate) or fuse into large masses (Clinkers) interfering with uniform airflow through the grate and fuel bed making it difficult for air flow.

Low Moisture - Dry coal can get entrained and carried out with the combustion gases resulting in high combustion losses.

FIG6-54nb/2

FIGURE 6-55: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Reduced Boiler Efficiency

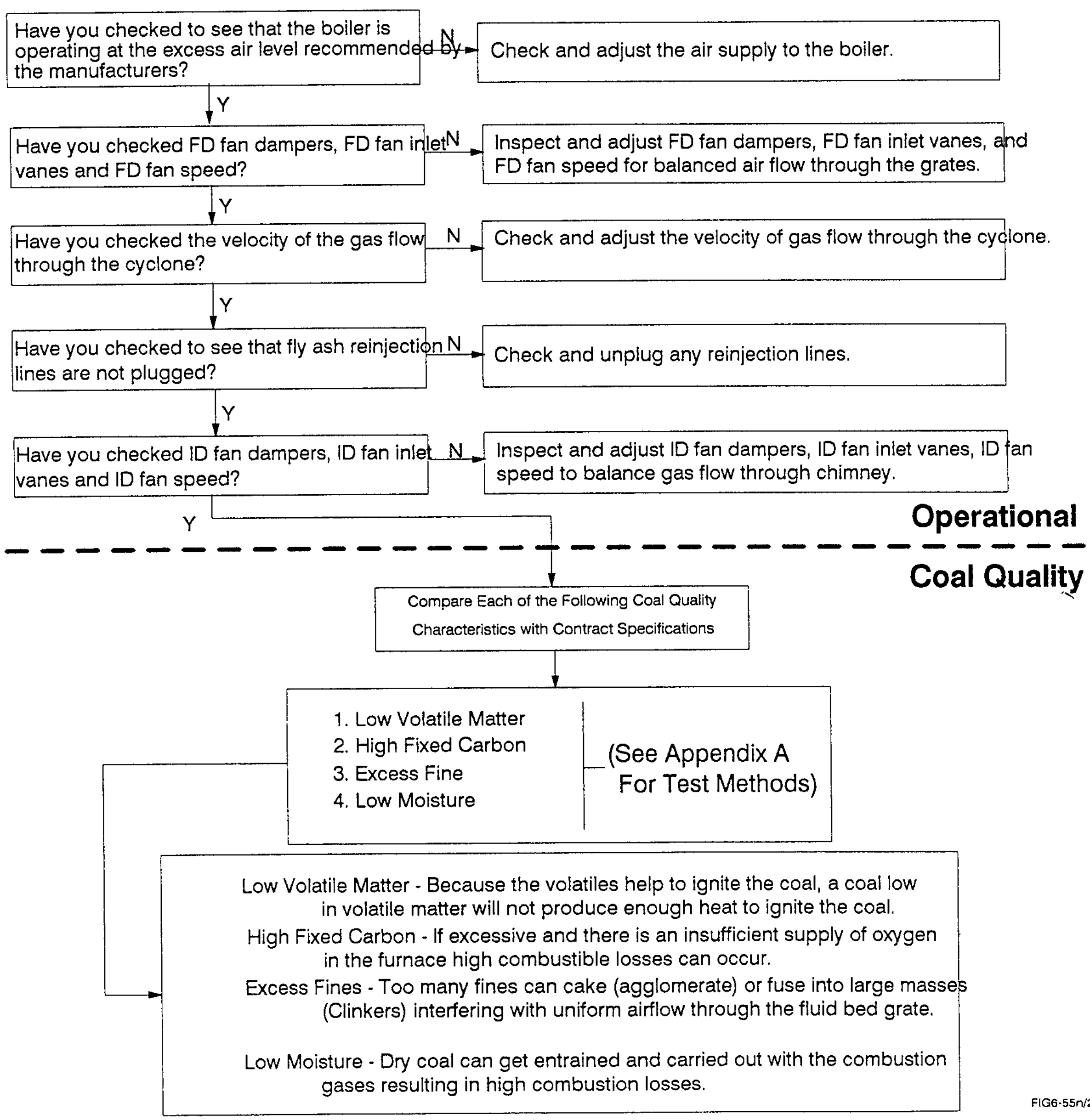


FIG6-55n/2

FIGURE 6-56: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Boiler Components

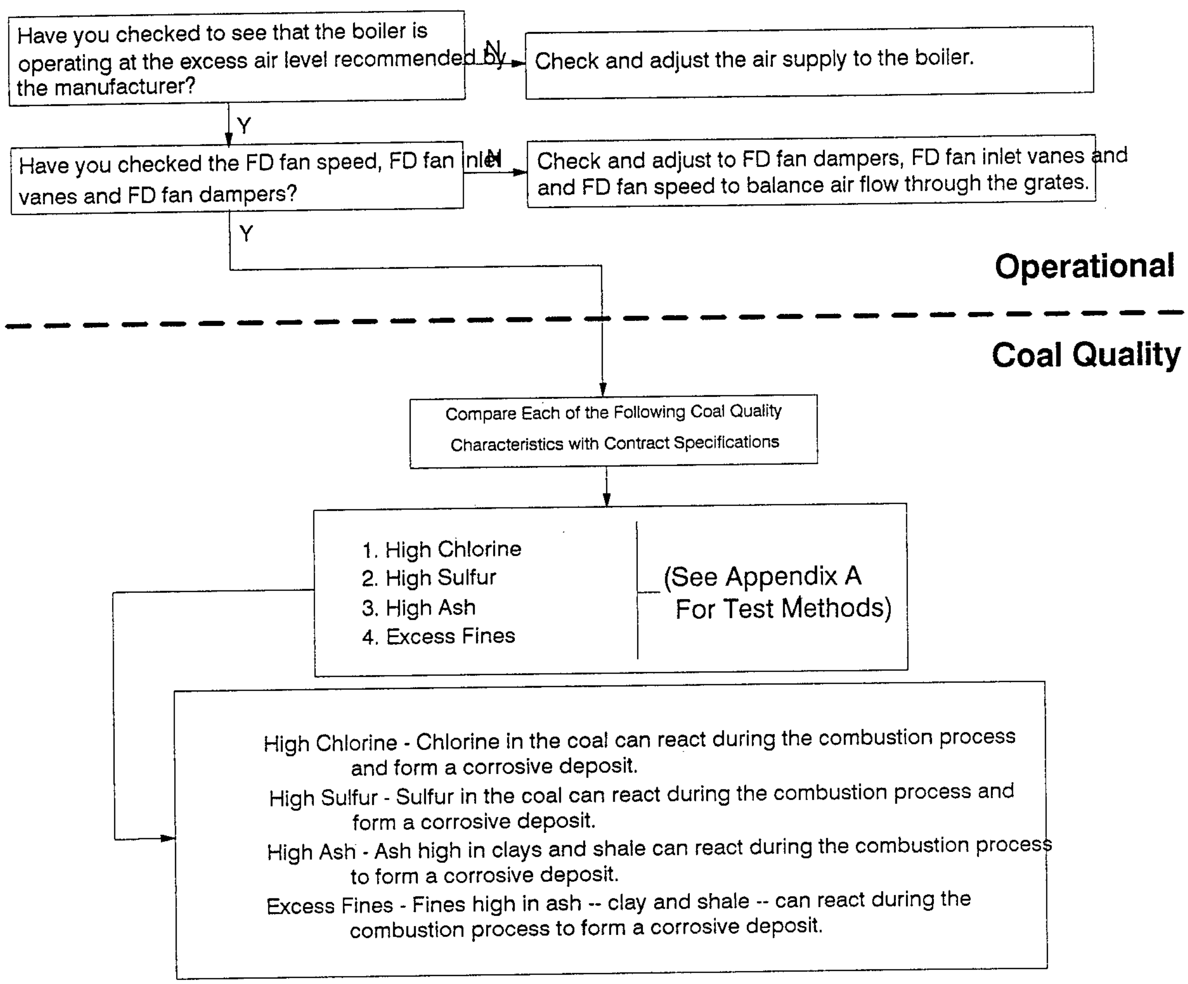


FIG6-56n/2

FIGURE 6-57: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Refractory Surfaces

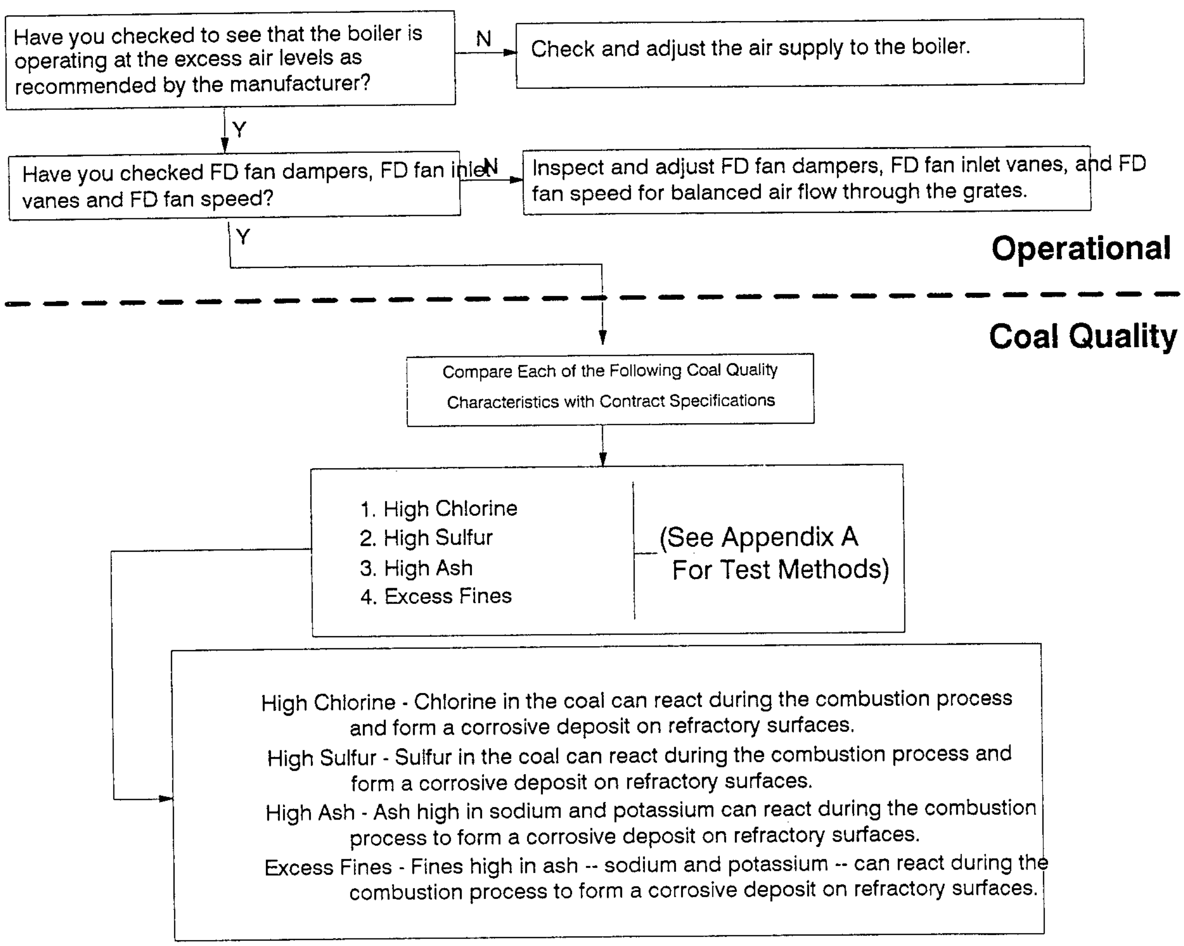
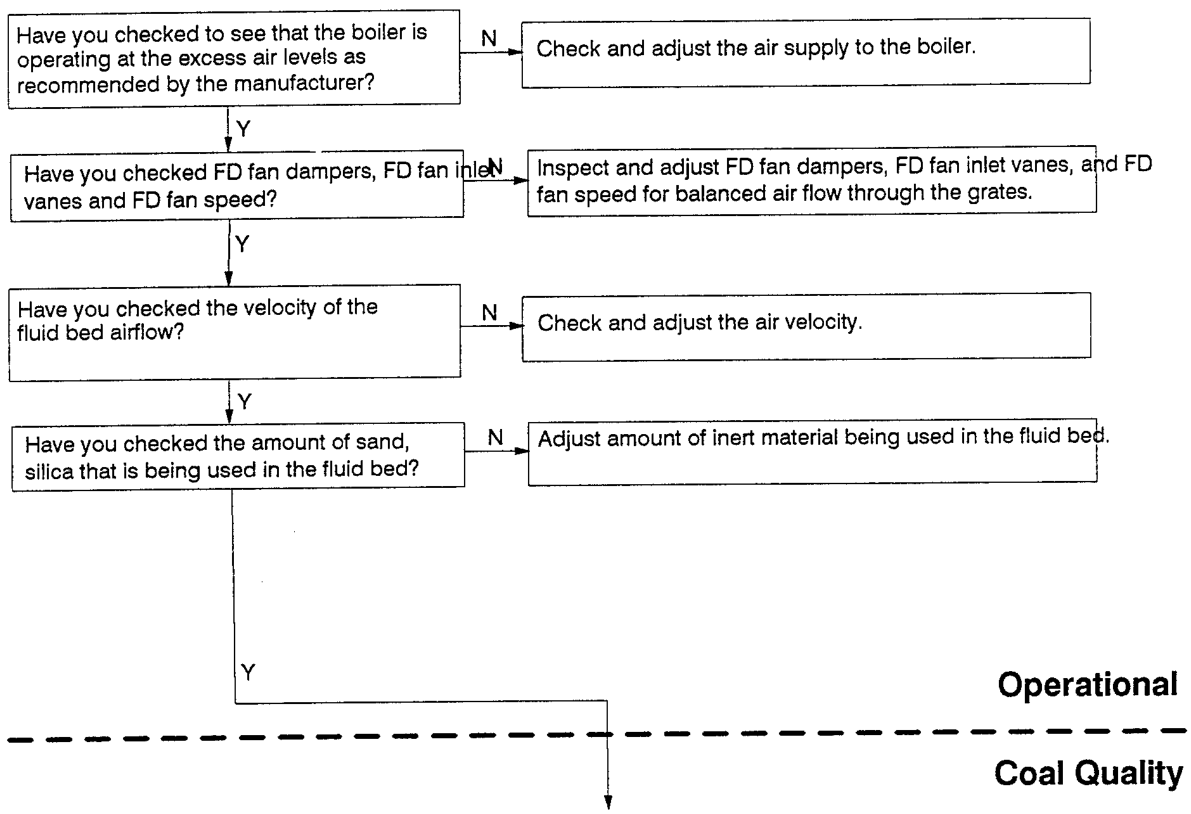


FIG6-57n/2

FIGURE 6-58: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Refractory Surfaces



See next page for Coal Quality Section

FIG6-58n/2

RE 6-58 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Erosion Of Refractory Surfaces

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on refractory surfaces eventually wearing away these surfaces.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

High Ash - Ash suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away these surfaces.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with refractory surfaces eventually wearing away the surface.

FIG6-58nb/2

FIGURE 6-59: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Slagging/Spalling Of Refractory Surfaces

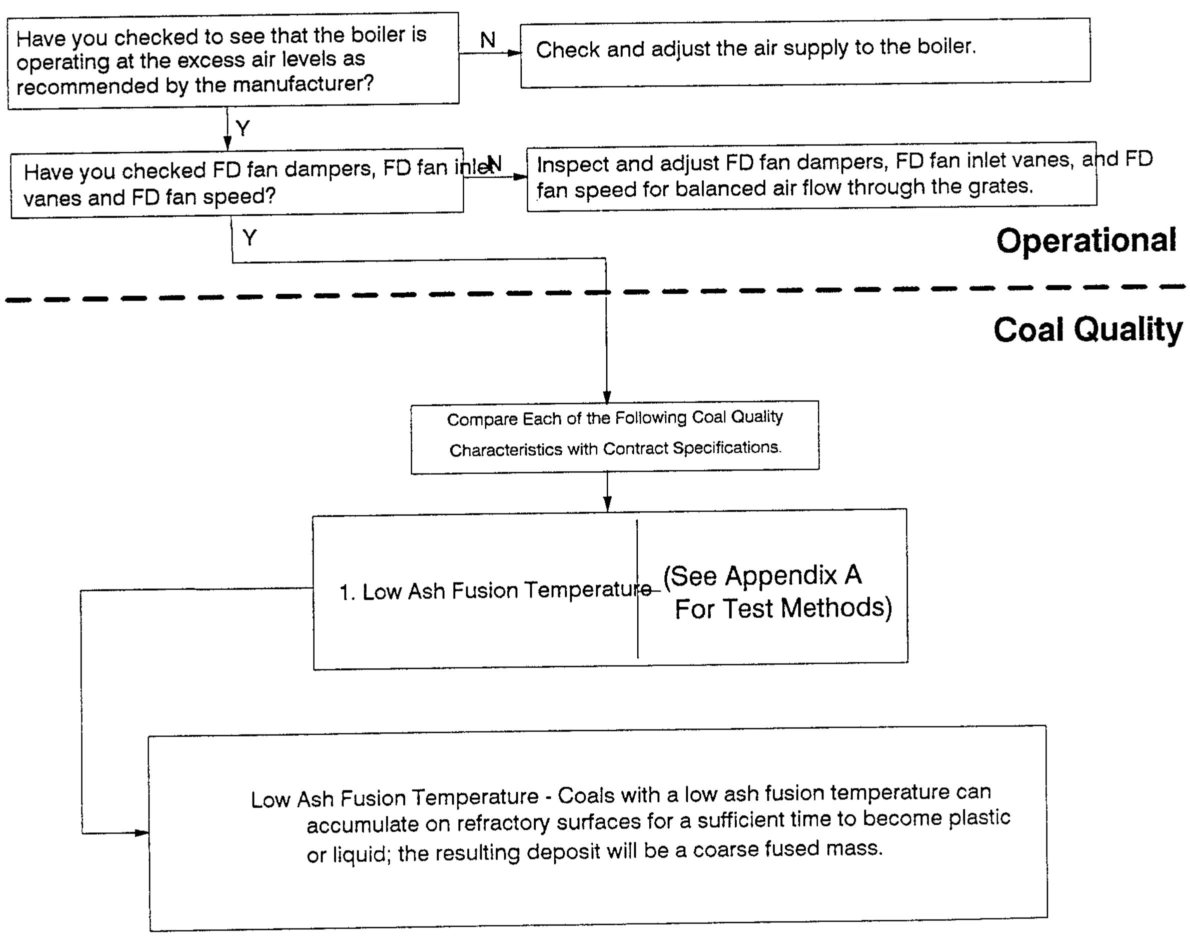


FIG6-59n/2

FIGURE 6-60: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

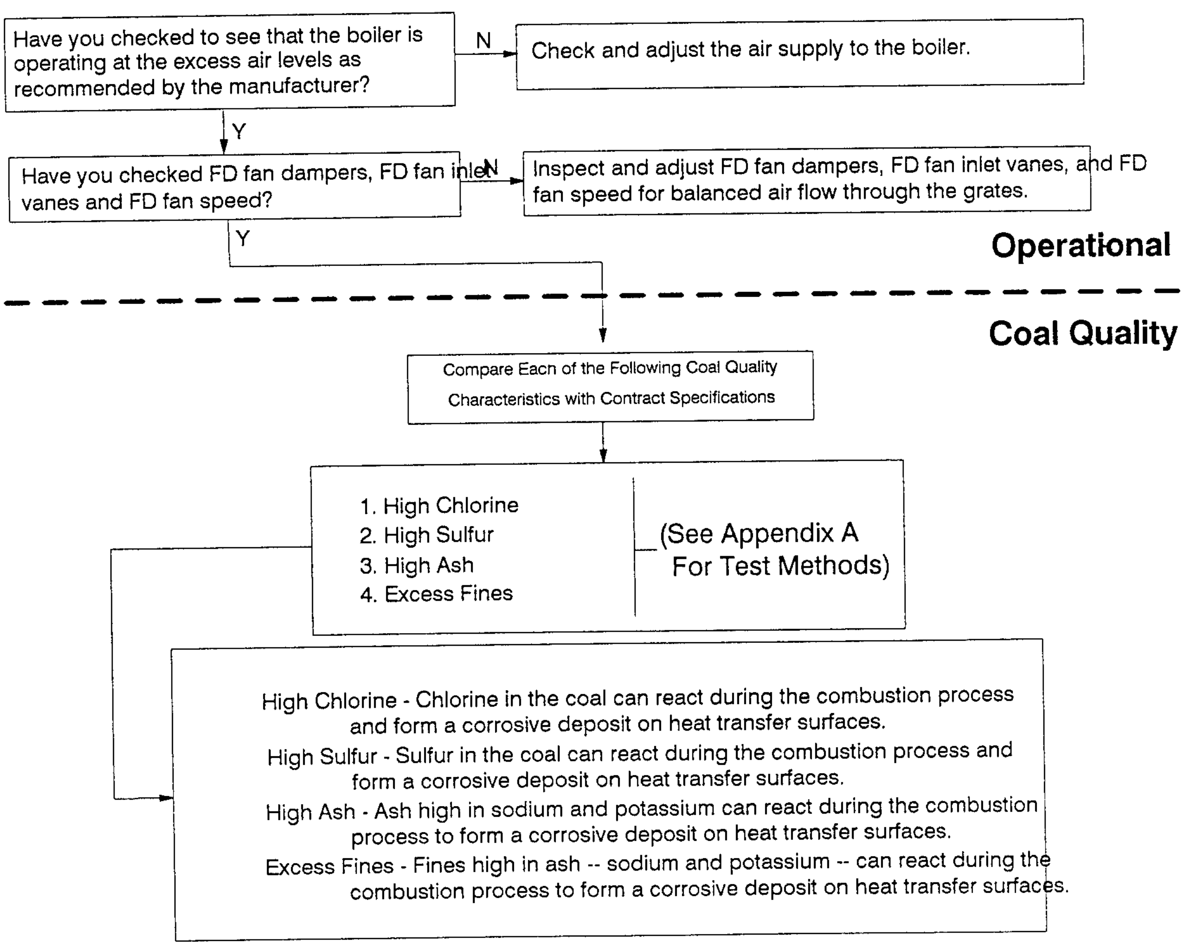
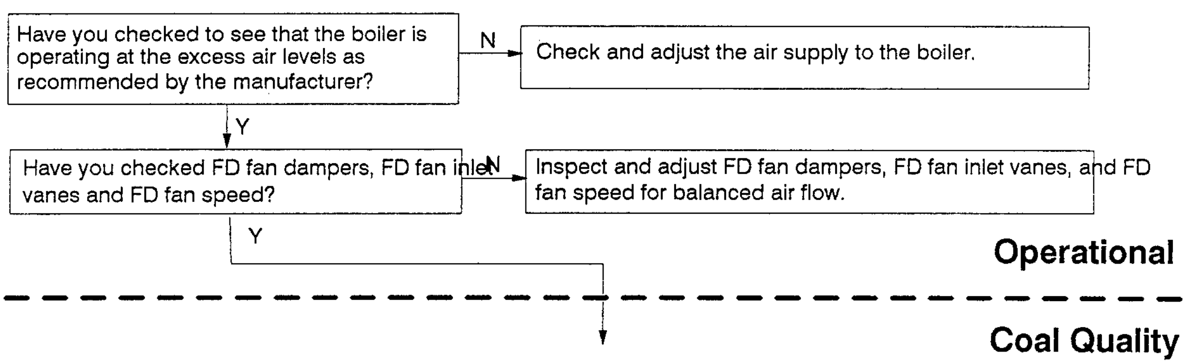


FIG6-60n/2

FIGURE 6-61: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Heat Transfer Surfaces

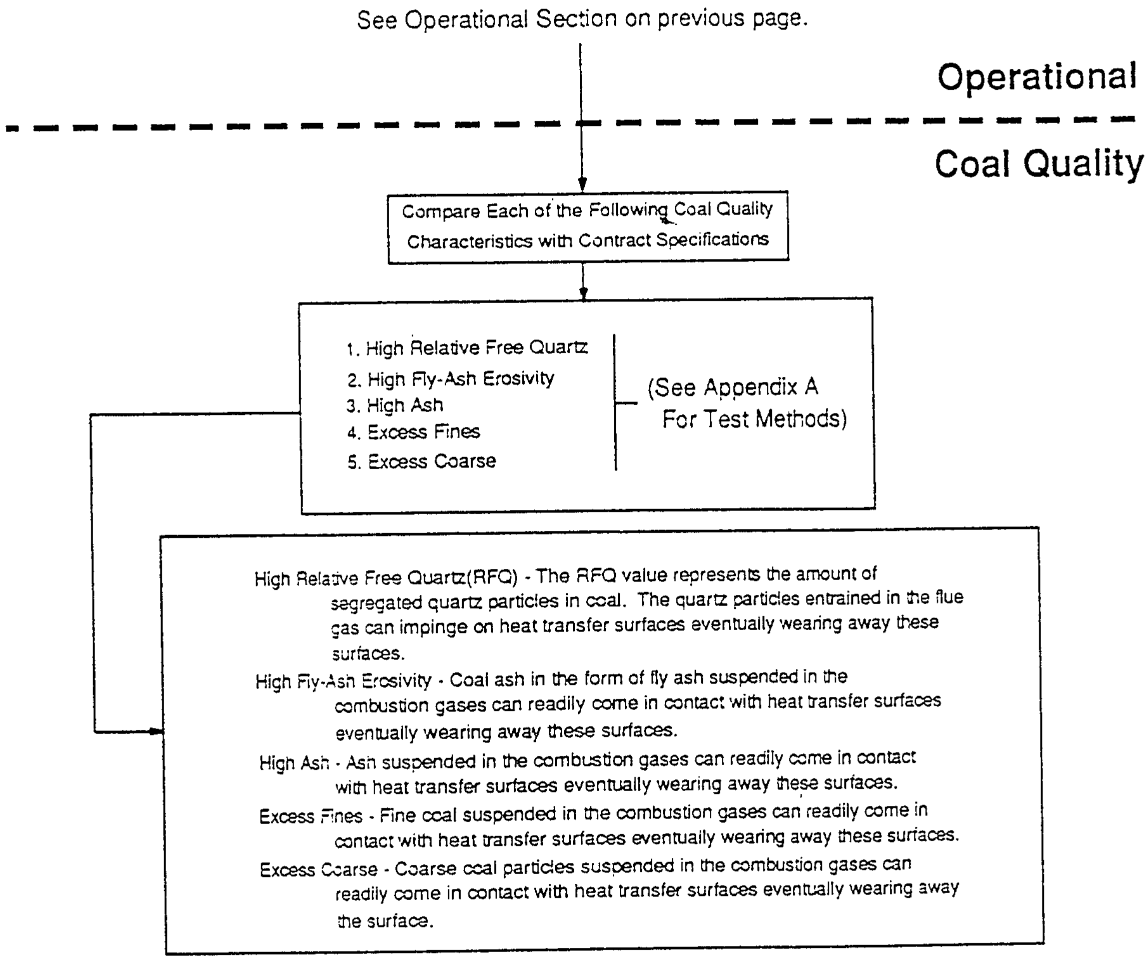
(Boiler Tubes and Water Walls)



See next page for Coal Quality Section

FIG6-61n/2

FIGURE 6-61: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Erosion Of The Heat Transfer Surfaces
(Boiler Tubes and Water Walls)



FIGS-69no/2

FIGURE 6-62: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Slagging Of Heat Transfer Surfaces
(Boiler Tubes and Water Walls)

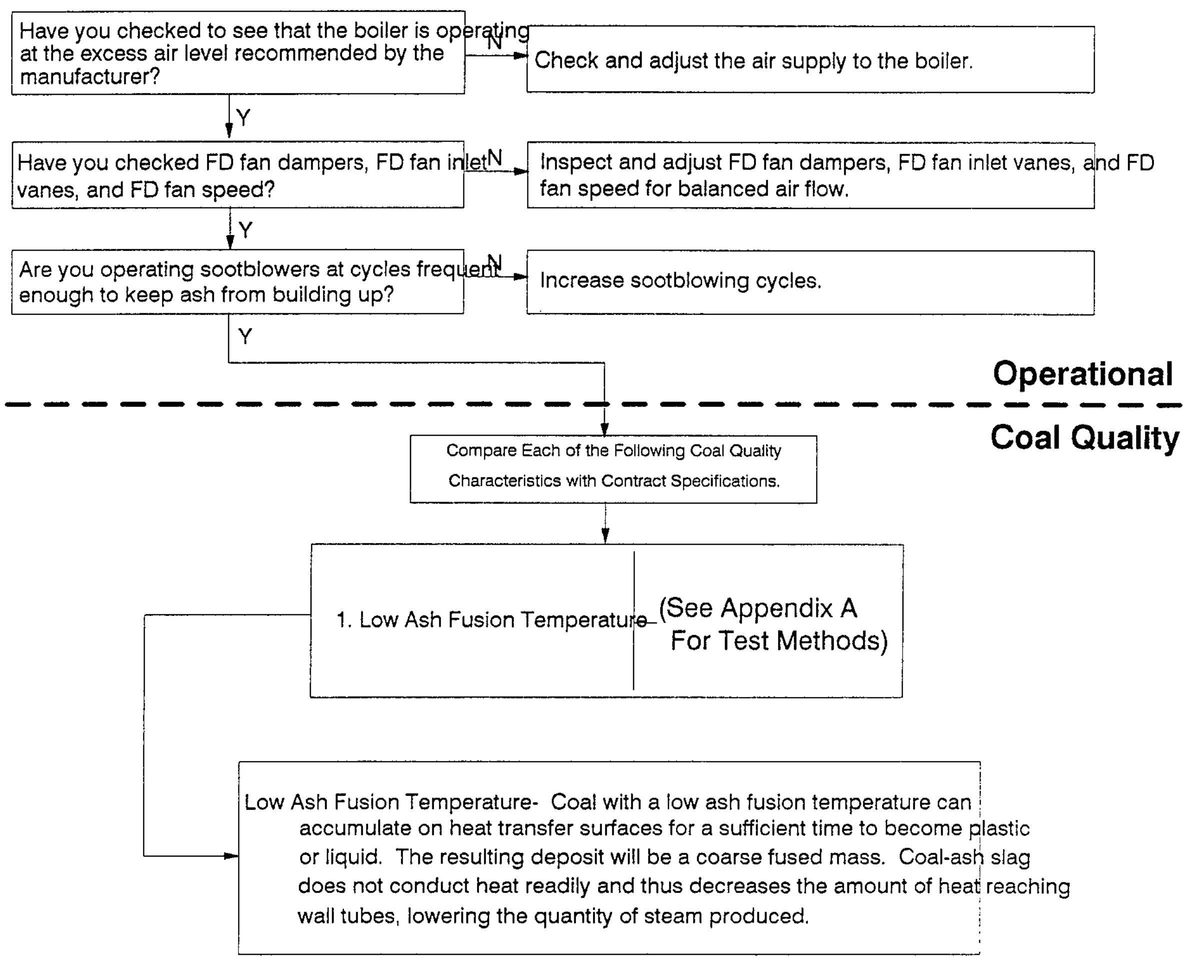


FIG6-62N/2

FIGURE 6-63: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Fouling Of Heat Transfer Surfaces

(Boiler Tubes and Water Walls)

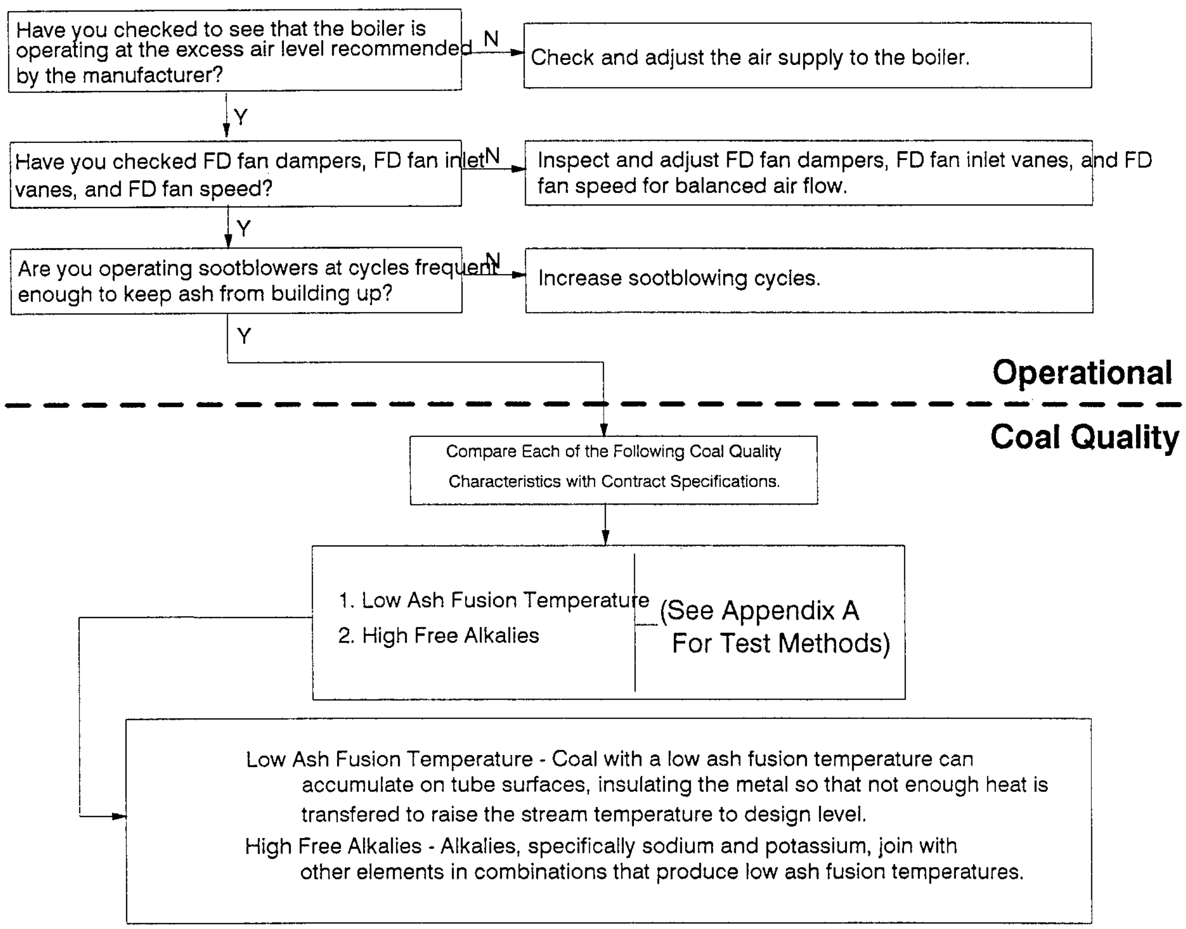


FIG6-63N/2

FIGURE 6-64: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Baffles

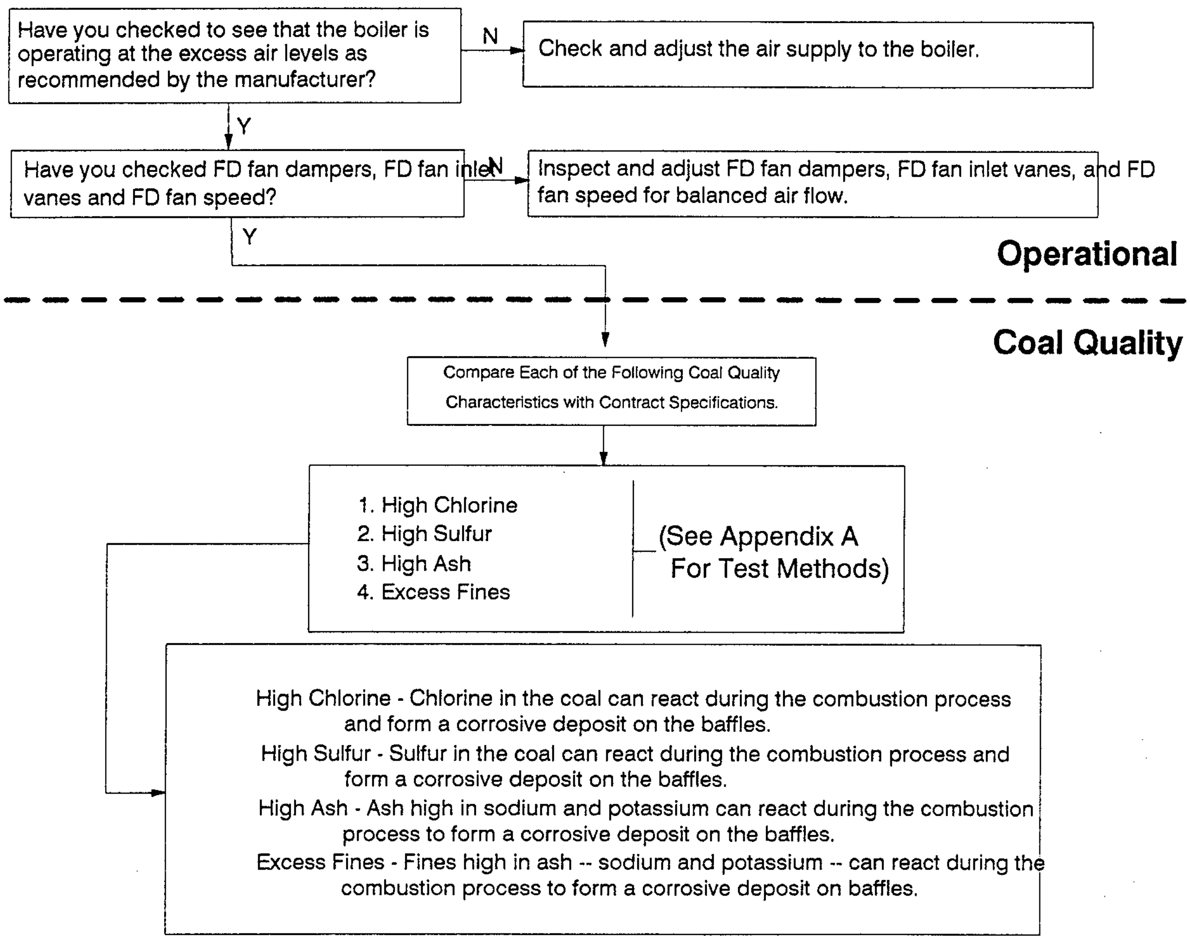
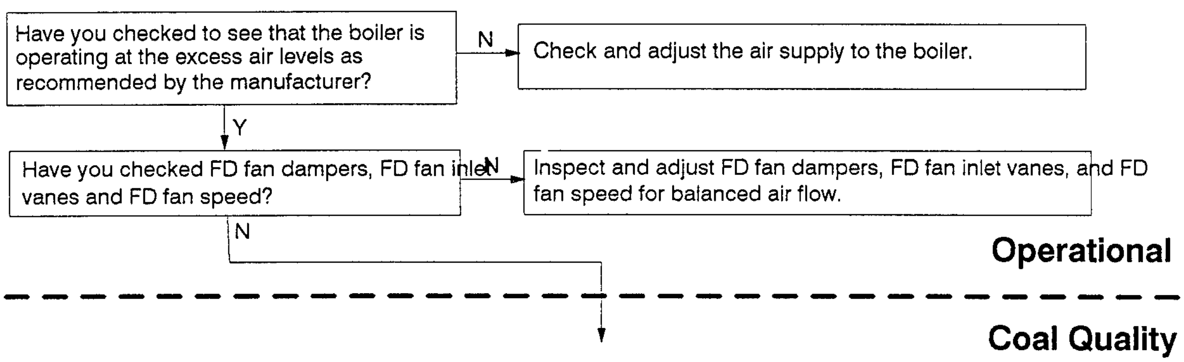


FIG6-64n/3

FIGURE 6-65: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Heat Transfer Surfaces

(Baffles)



See next page for Coal Quality Section

FIG6-65n/2

RE 6-65 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Erosion Of Heat Transfer Surfaces
(Baffles)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on baffles eventually wearing away the surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the baffles eventually wearing away the surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with baffles eventually wearing away the surface.

FIG6-65nb/2

FIGURE 6-66: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Slagging Of Heat Transfer Surfaces (Baffles)

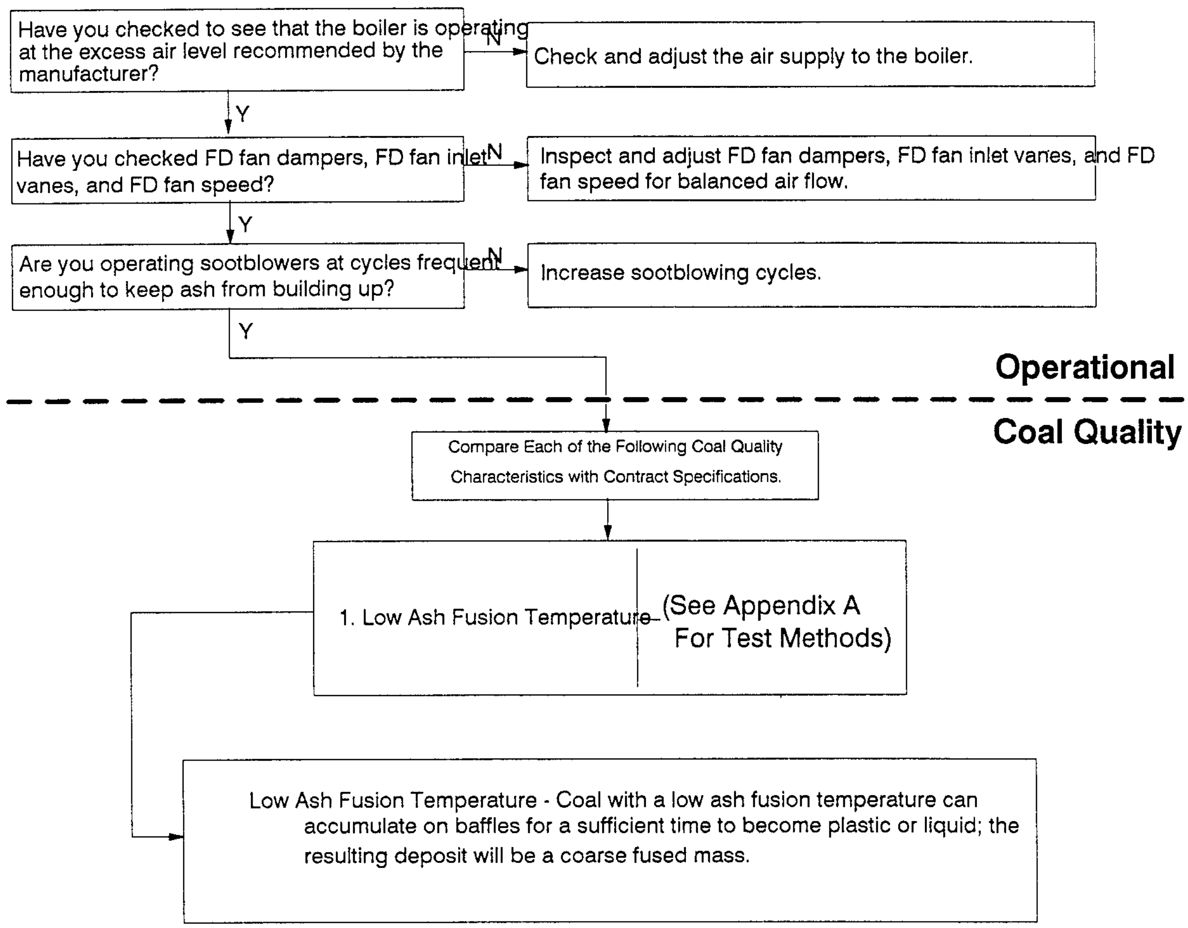


FIG6-66N/2

FIGURE 6-67: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Fouling Of Heat Transfer Surfaces
(Baffles)

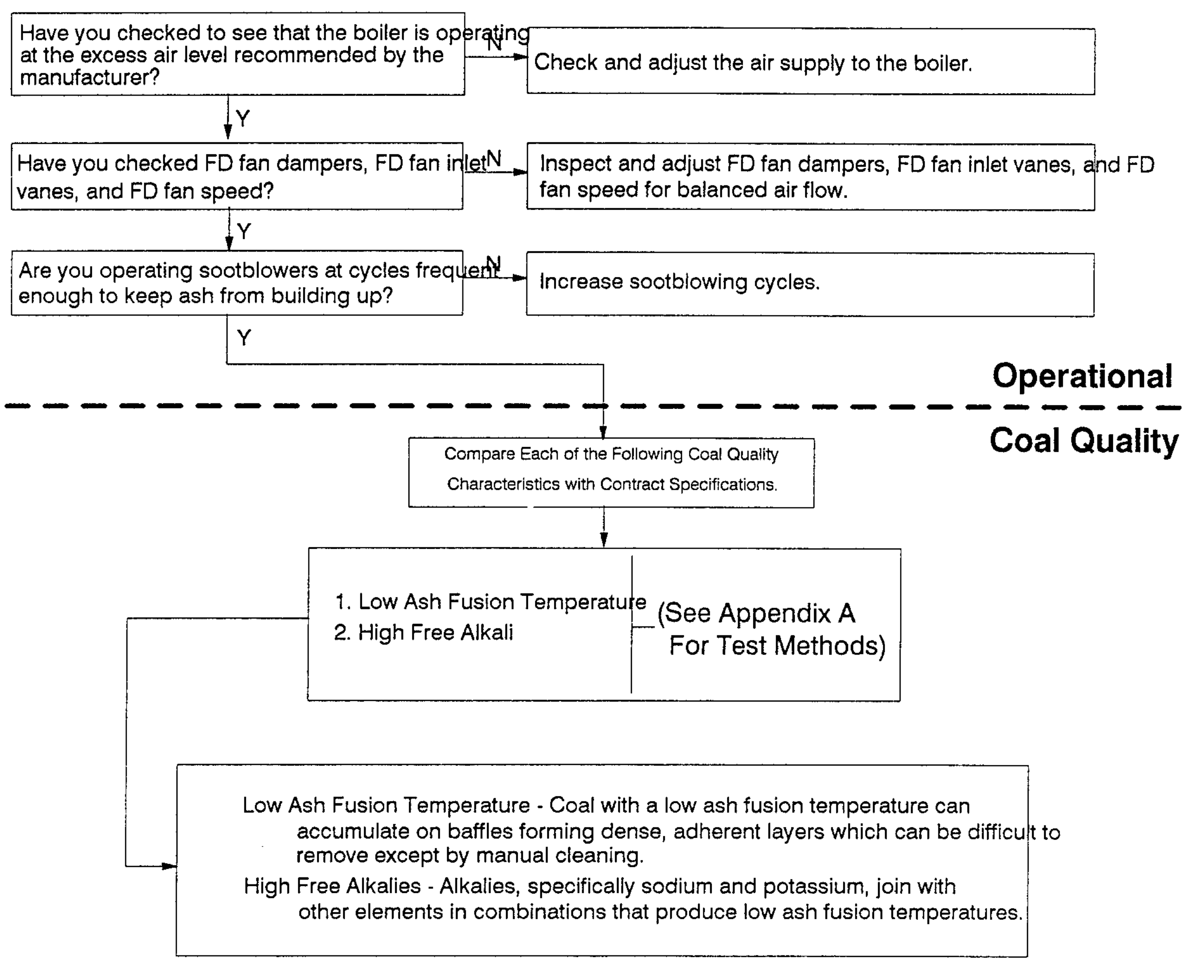


FIG6-67N/2

FIGURE 6-68: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Insufficient Capacity And Inability To Meet Load
(Forced Draft Fan)

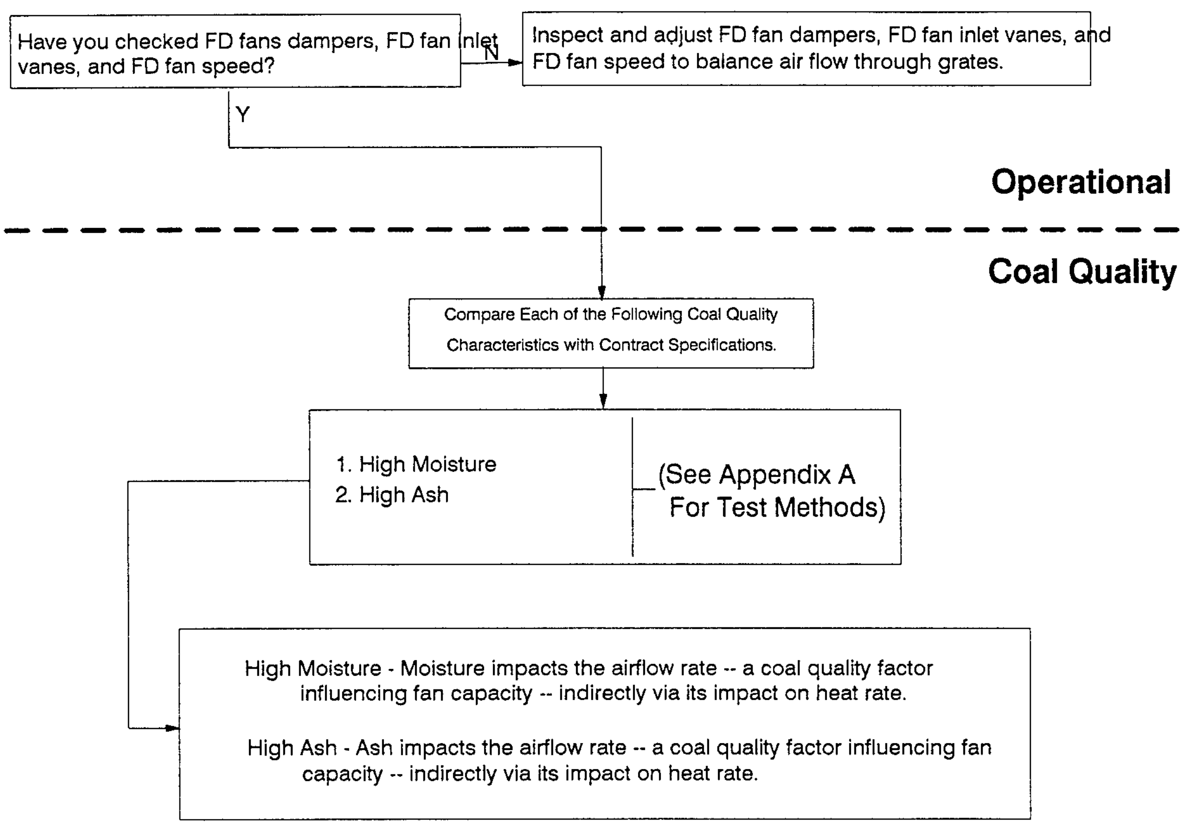


FIG6-68n/3

FIGURE 6-69: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Smoking Around The Forced Draft Fan

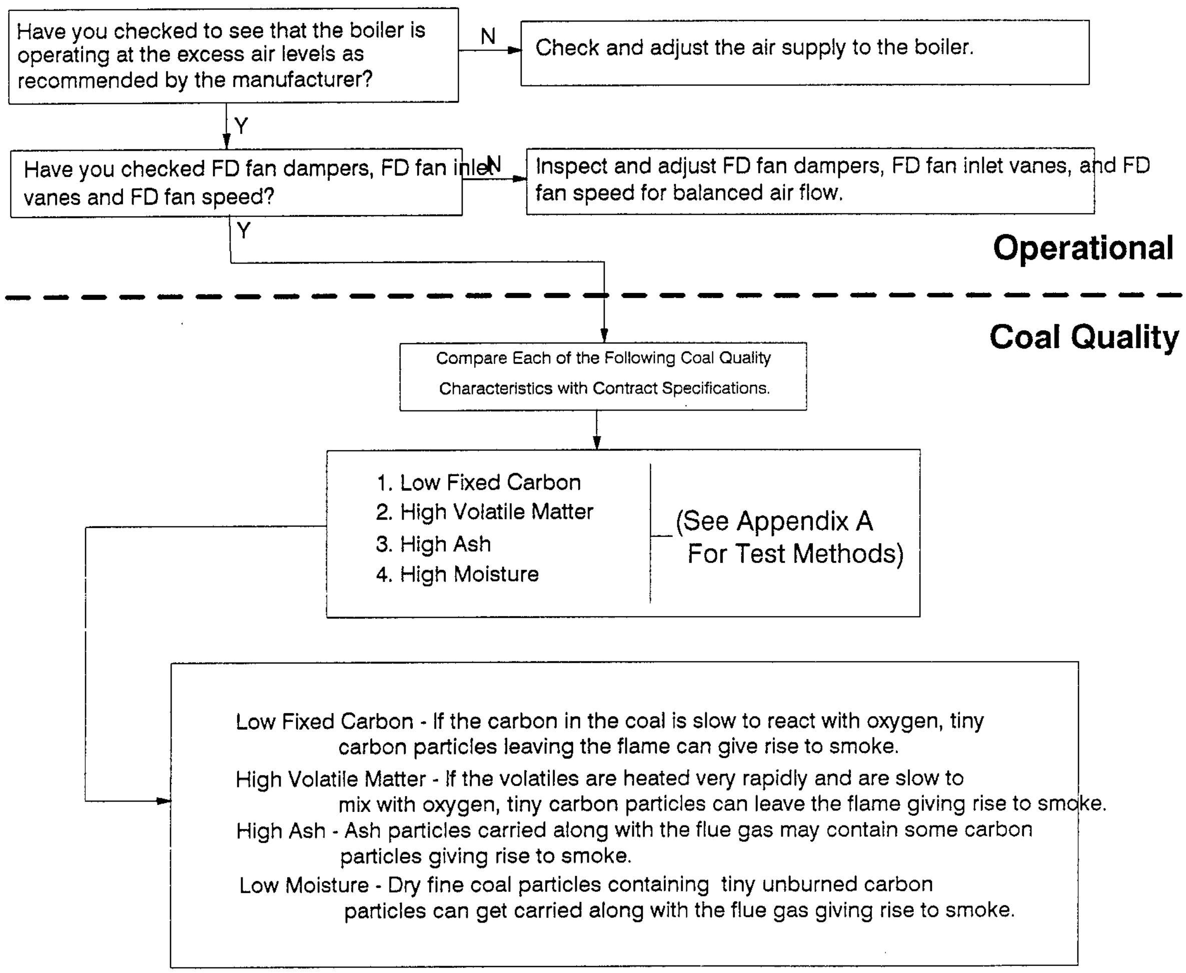


FIG6-69n/3

FIGURE 6-70: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Insufficient Capacity And Inability To Meet Load

(Induced Draft Fan)

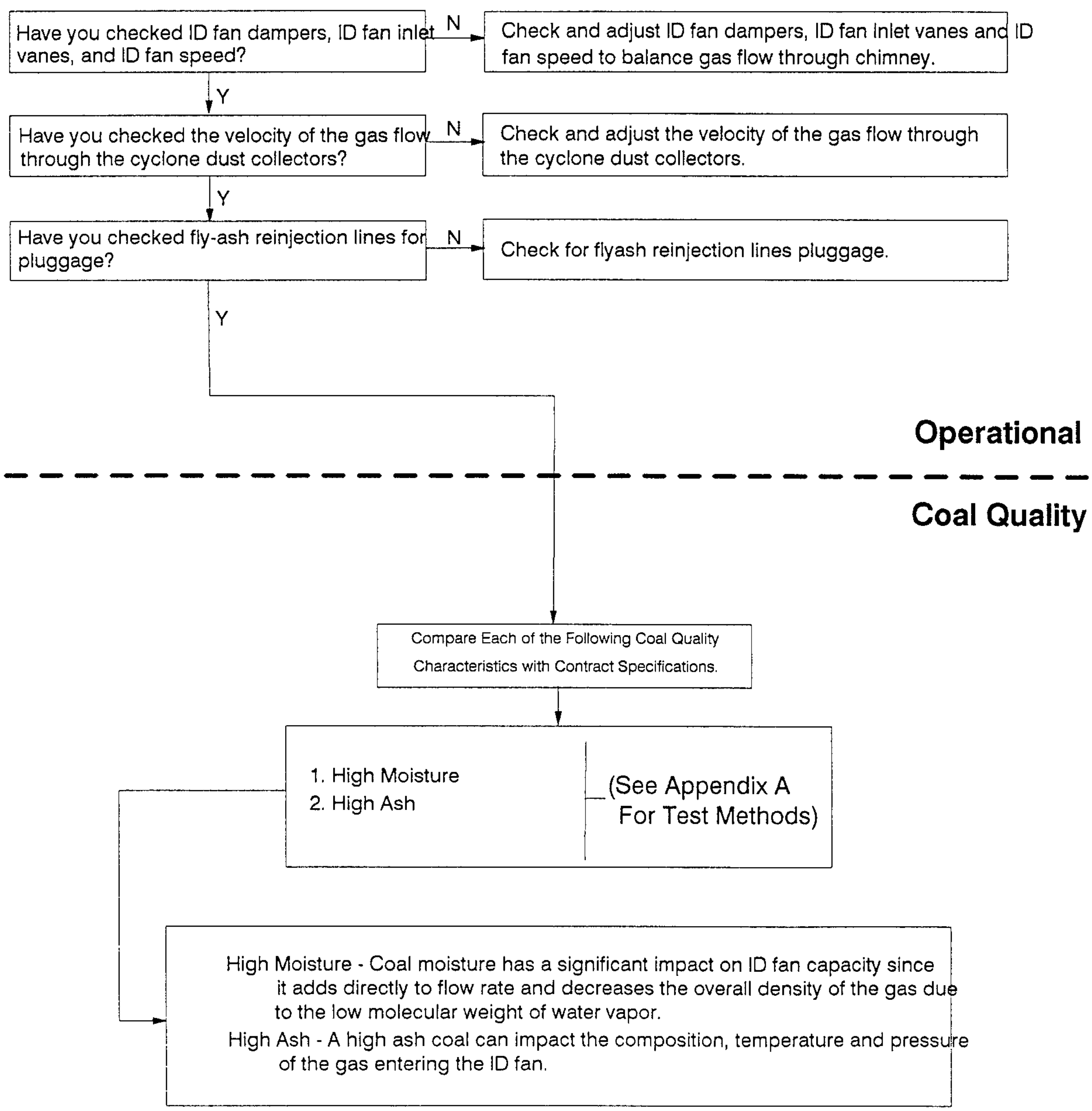


FIG6-70n/3

FIGURE 6-71: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Corrosion Of The Induced Draft Fan

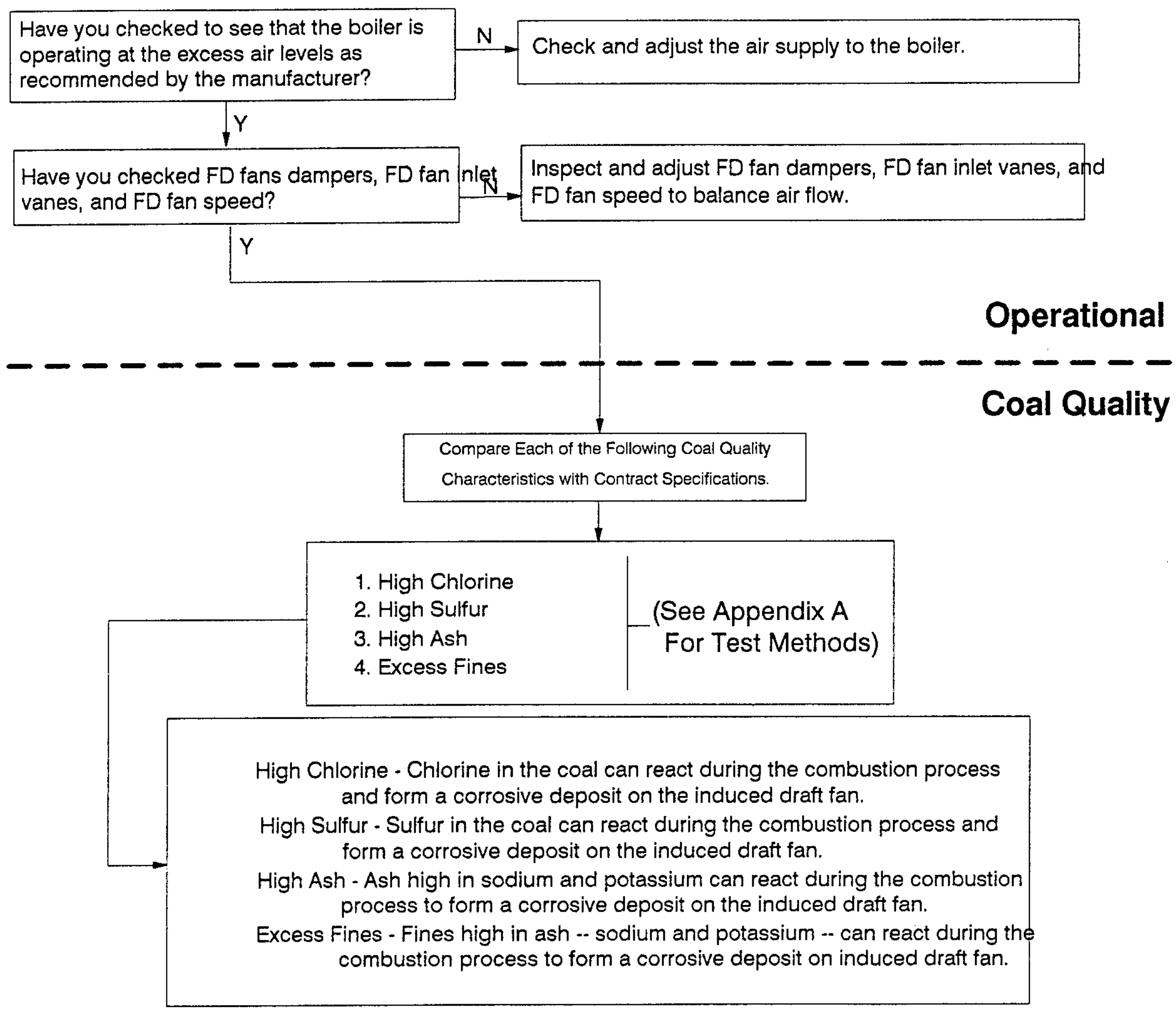
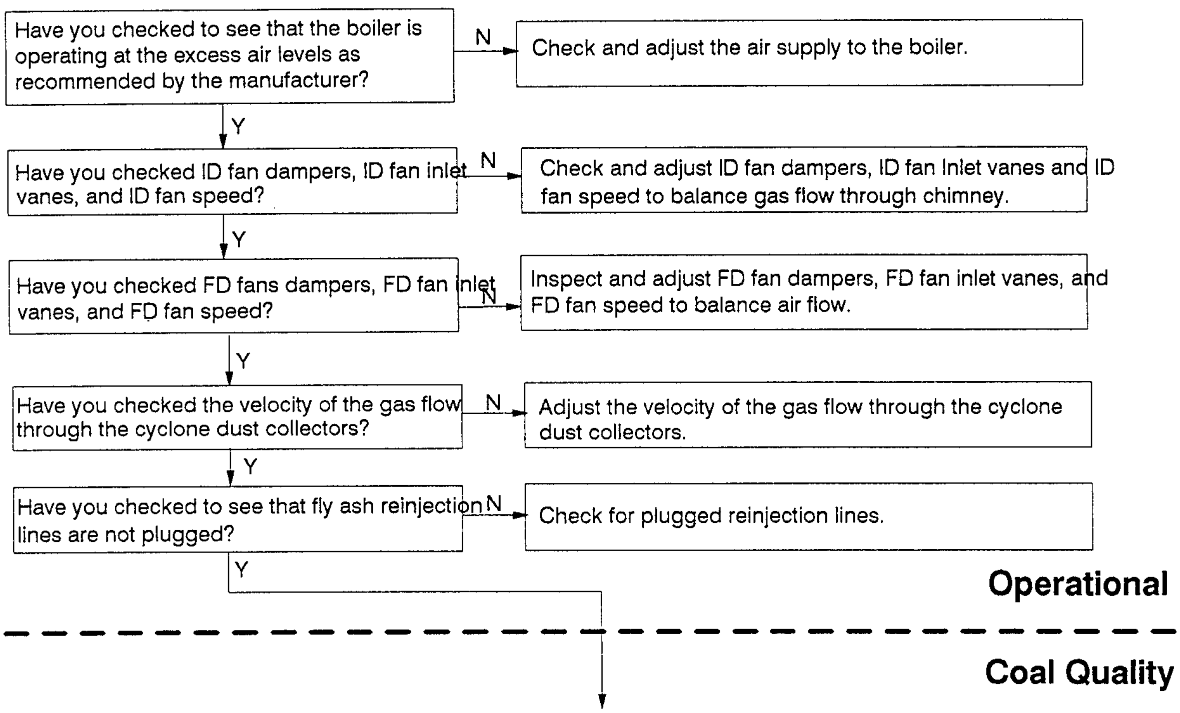


FIG6-71n/3

FIGURE 6-72: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Smoking From The Induced Draft Fan



See next page for the Coal Quality Section.

FIG6-72n/3

RE 6-72 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG

For Smoking From The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

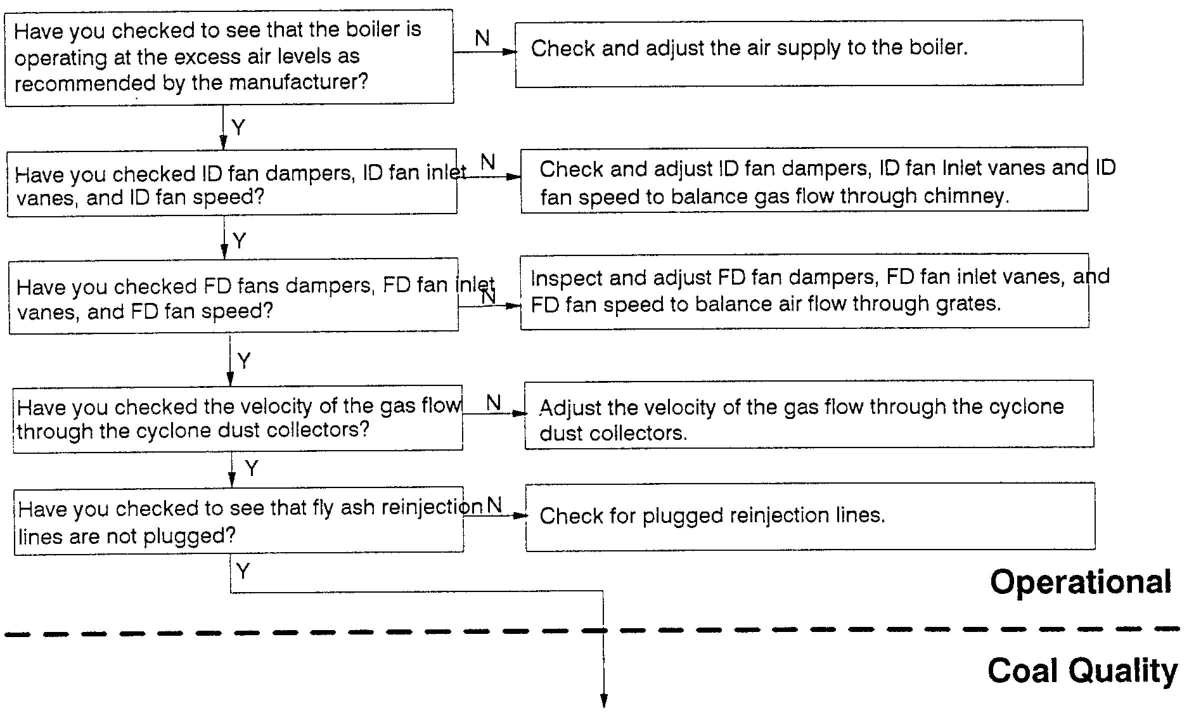
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG6-72B

FIGURE 6-73: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Induced Draft Fan



See next page the Coal Quality Section.

FIG6-73n/3

RE 6-73 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG

For Erosion Of The Induced Draft Fan

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the induced draft fan eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

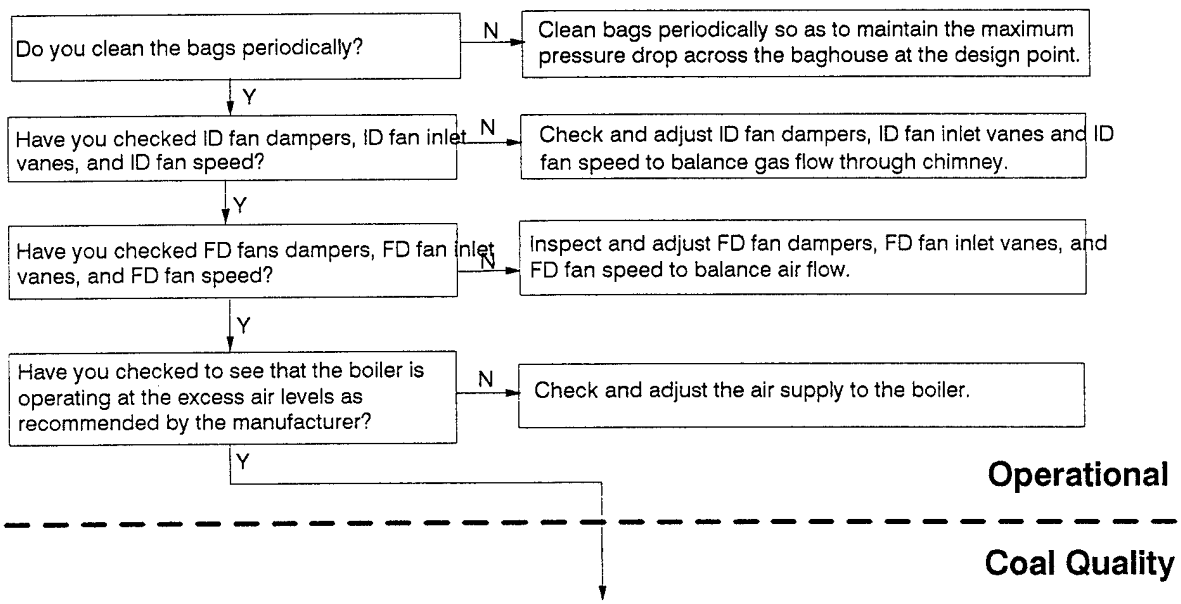
Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with induced draft fan eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the induced draft fan eventually wearing away the metal surface.

FIG6-73nb/3

FIGURE 6-74: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout From The Particulate Removal System (Baghouse)



See next page the Coal Quality Section.

FIG6-74n/3

RE 6-74 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Carbon Burnout From The Particulate Removal System (Baghouse)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG6-74nb/3

FIGURE 6-75: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Excess Particulate Emissions From The Particulate Removal System (Baghouse)

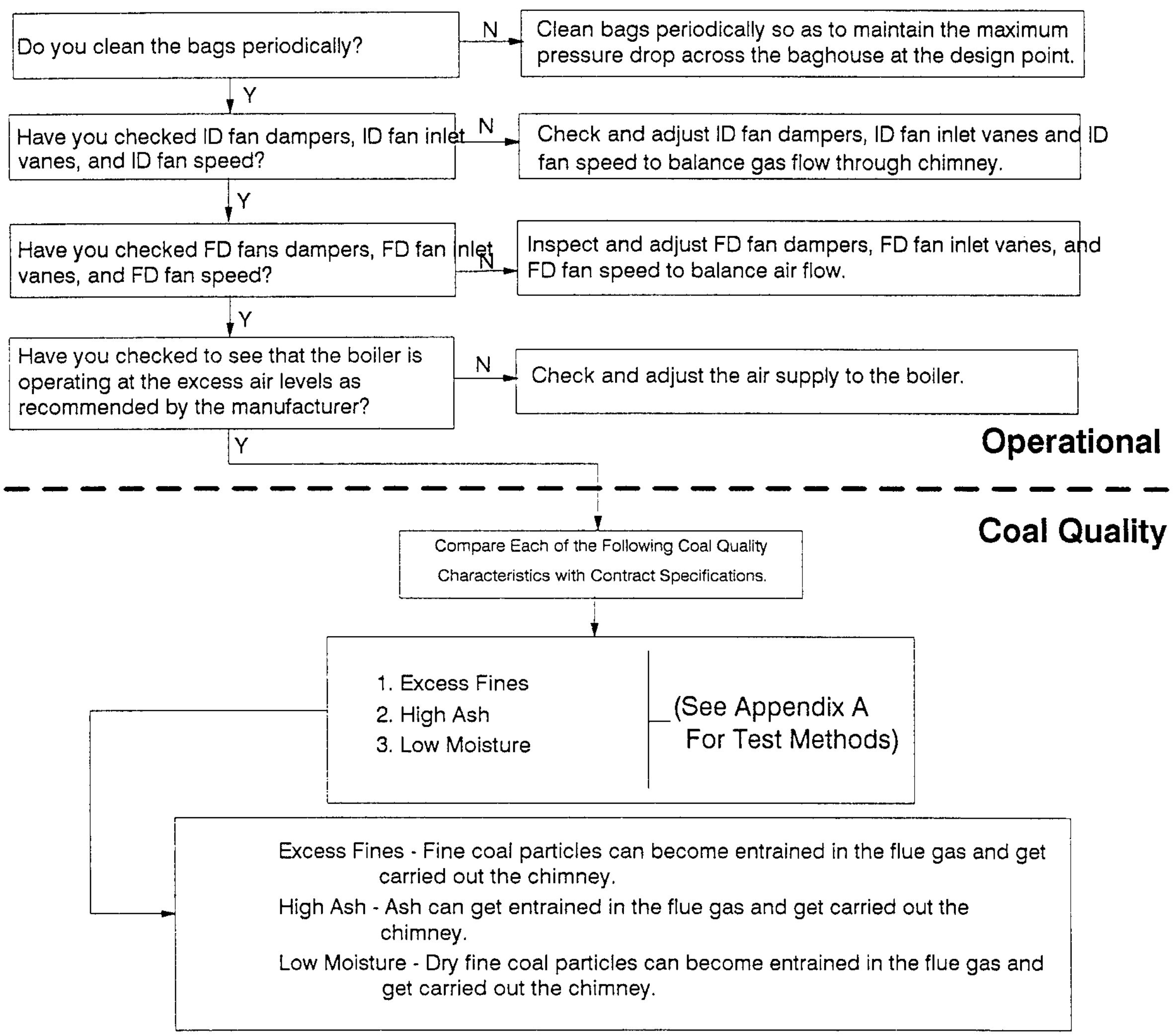
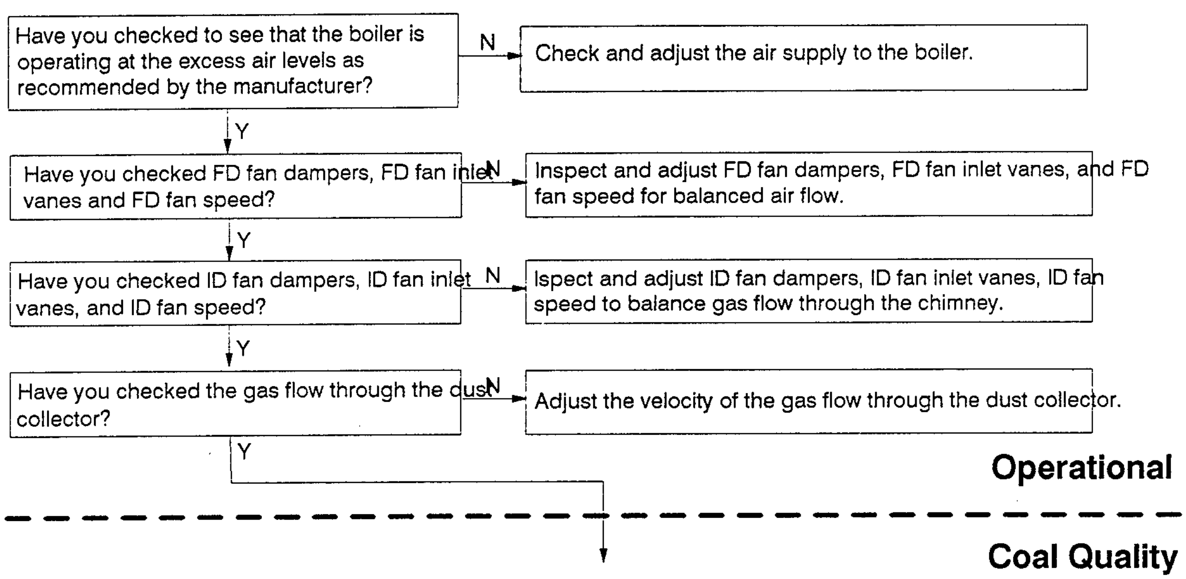


FIG6-75n/3

FIGURE 6-76: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System

(Cyclone)



See next page for Coal Quality Section

FIG6-76n/3

RE 6-76 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Carbon Burnout In The Particulate Removal System
(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

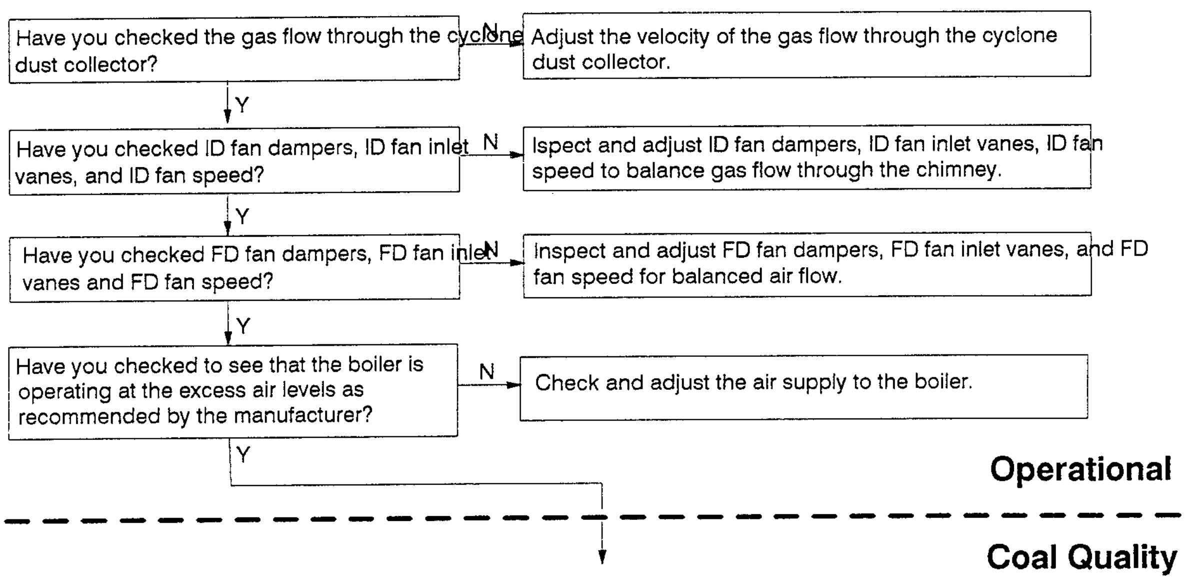
High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG6-76nb/3

FIGURE 6-77: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion In The Particulate Removal System

(Cyclone)



See next page for Coal Quality Section

FIG6-77n/3

RE 6-77 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG

For Erosion In The Particulate Removal System

(Cyclone)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on the cyclone and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with the cyclone and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with cyclone eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away the metal surface.

Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with the cyclone eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with the cyclone and wear away metal surfaces.

FIG6-77nb/3

FIGURE 6-78: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Cyclone)

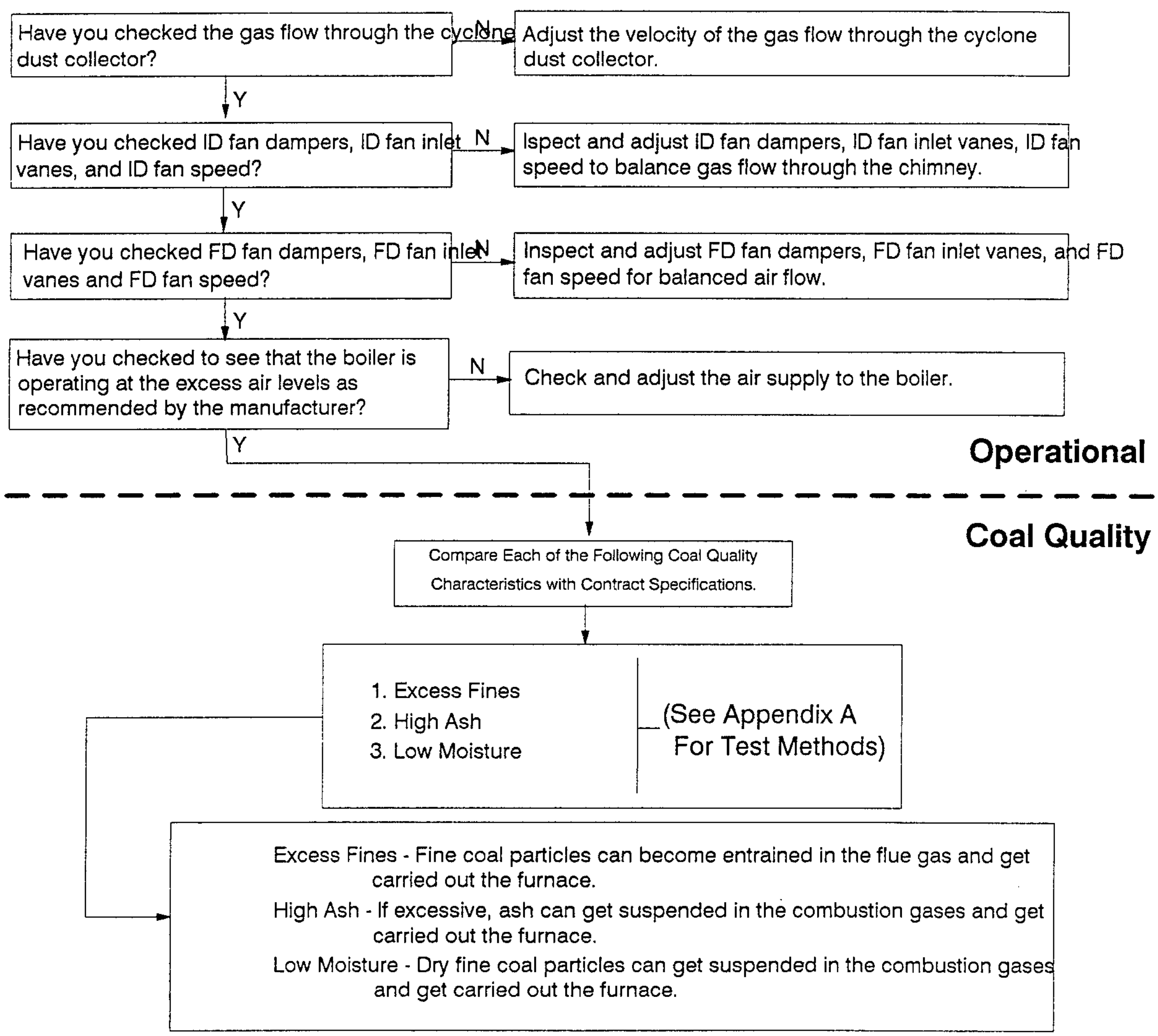
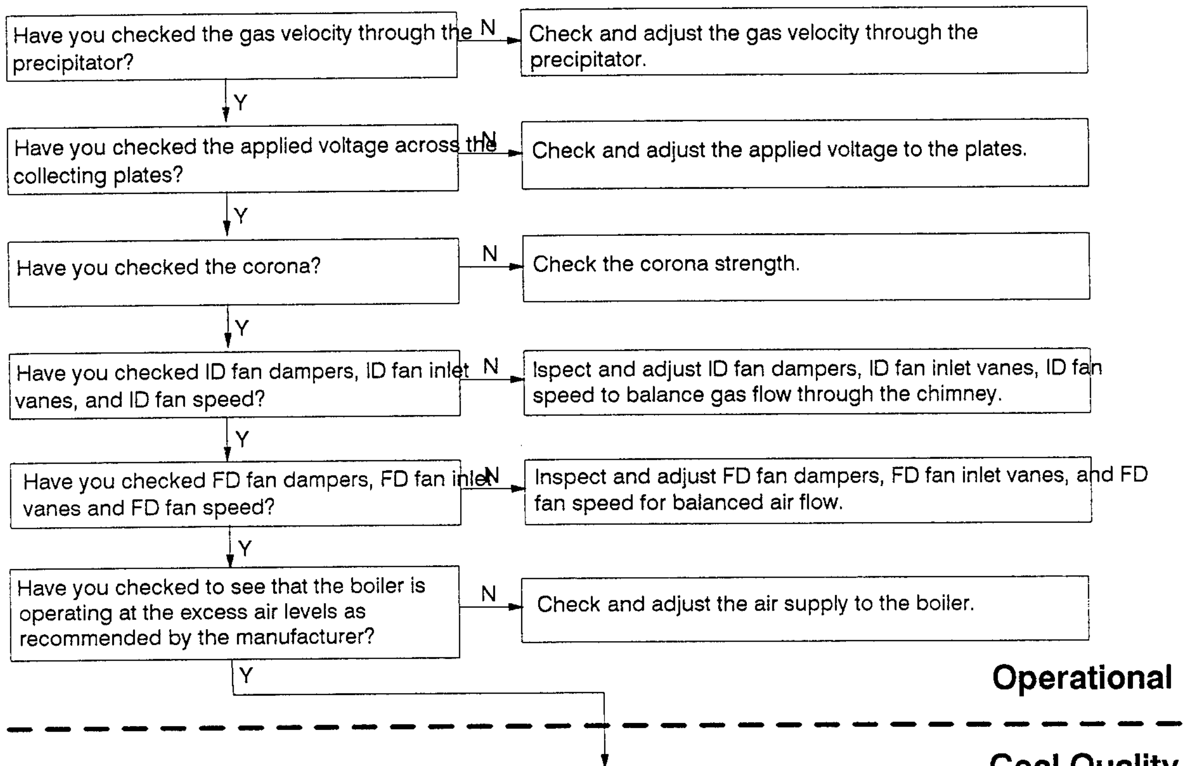


FIG6-78n/3

FIGURE 6-79: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Particulate Removal System

(Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG6-79n/3

RE 6-79 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG

For Carbon Burnout In The Particulate Removal System (Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

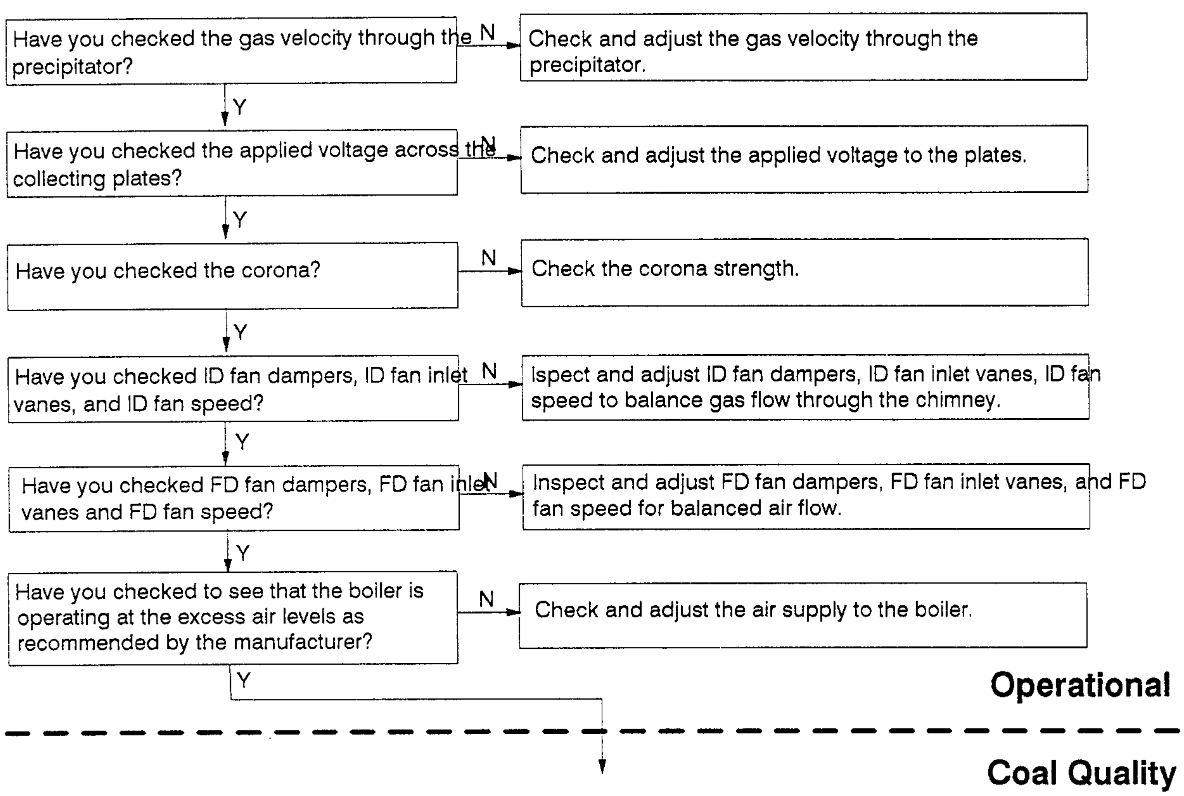
High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG6-79nb/3

FIGURE 6-80: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Erosion Of The Particulate Removal System

(Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG6-80n/3

RE 6-80 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Erosion Of The Particulate Removal System
(Electrostatic Precipitator)

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Relative Free Quartz
2. High Fly-Ash Erosivity
3. High Ash
4. Excess Fines
5. Excess Coarse
6. Low Moisture

(See Appendix A For Test Methods)

High Relative Free Quartz(RFQ) - The RFQ value represents the amount of segregated quartz particles in coal. The quartz particles entrained in the flue gas can impinge on and eventually wearing away the metal surface.

High Fly-Ash Erosivity - Coal ash in the form of fly ash suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

High Ash - Ash suspended in the combustion gases can readily come in contact with eventually wearing away the metal surface.

Excess Fines - Fine coal suspended in the combustion gases can readily come in contact with and eventually wearing away the metal surface.

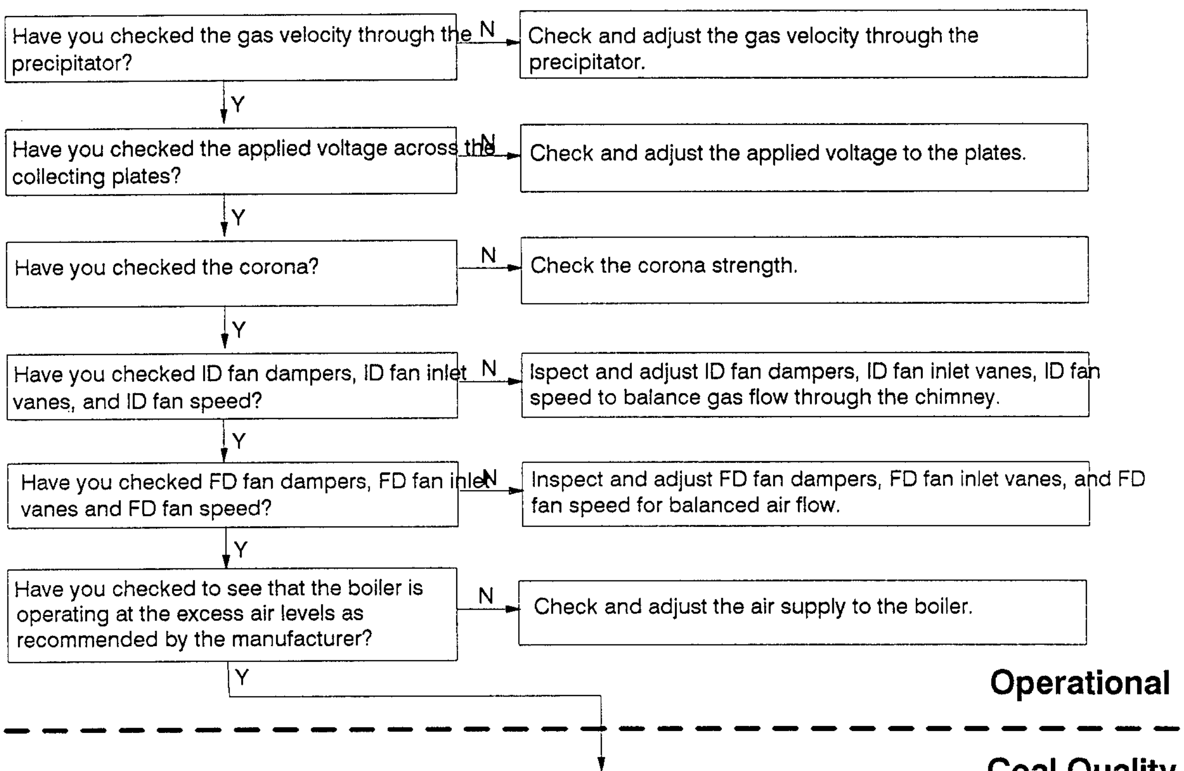
Excess Coarse - Coarse coal particles suspended in the combustion gases can readily come in contact with and eventually wearing away metal surfaces.

Low Moisture - A very dry coal can become entrained in the combustion gases and readily come in contact with and wear away metal surfaces.

FIG6-80nb/3

FIGURE 6-81: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System (Electrostatic Precipitator)



See next page for Coal Quality Section.

FIG6-81n/3

FIGURE 6-81 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Excess Particulate Emissions From The Particulate Removal System

(Electrostatic Precipitator)

See previous page for Operational Section.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Fly Ash Resistivity
2. High Ash
3. Low Sulfur
4. Excess Fines
5. Low Moisture

(See Appendix A For Test Methods)

Fly Ash Resistivity - The resistivity of the fly ash is the key parameter which limits the applied voltage and hence the collection efficiency for a given precipitator design and operating configuration.

High Ash - If excessive, ash can get suspended in the combustion gases and get carried out the furnace. A high calcium content in the ash reduces the effective sulfur trioxide concentration, thereby decreasing precipitator performance. Sulfur trioxide is important in the resistivity mechanism because water molecules in combination with sulfur trioxide are absorbed on the surface of the ash particles and form a conductive film, shich decrease resistivity.

Low Sulfur - Ash from coals low in sulfur is more difficult to precipitate than ash from higher sulfur coals.

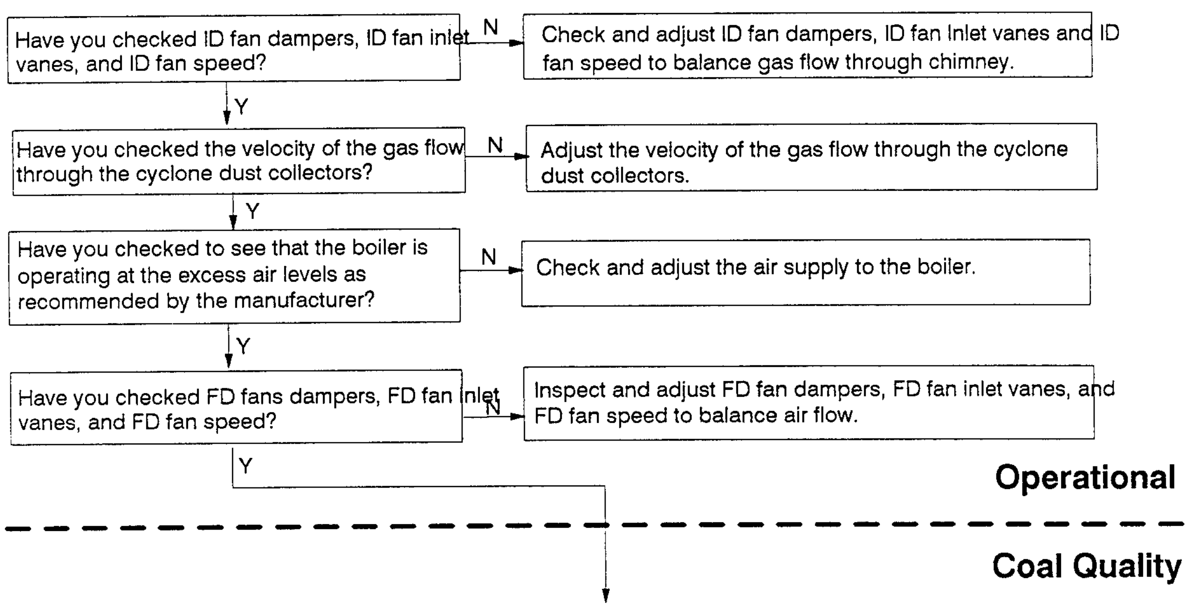
Excess Fines - Fine coal particles can become entrained in the flue gas and get carried out the furnace.

Low Moisture - Dry fine coal particles can get suspended in the combustion gases and get carried out the furnace.

FIG6-81nb/3

FIGURE 6-82: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Fly-Ash Recycle



See next page for the Coal Quality Section.

FIG6-82n/3

RE 6-82 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Carbon Burnout In The Fly-Ash Recycle

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG6-82nb/3

FIGURE 6-83: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Ash Hopper/Pit

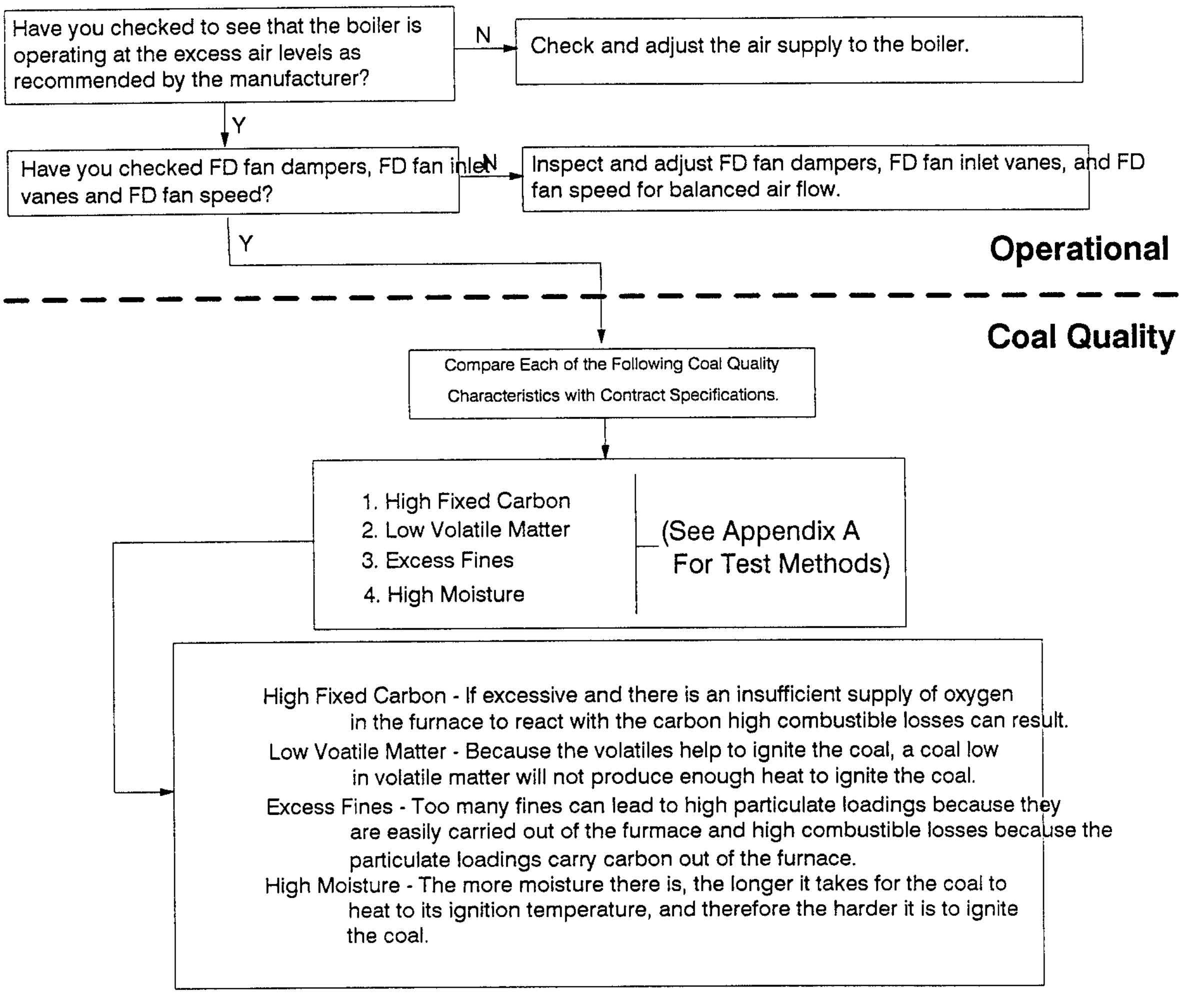


FIG6-83n/3

FIGURE 6-84: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Corrosion Of The Stack/Chimney

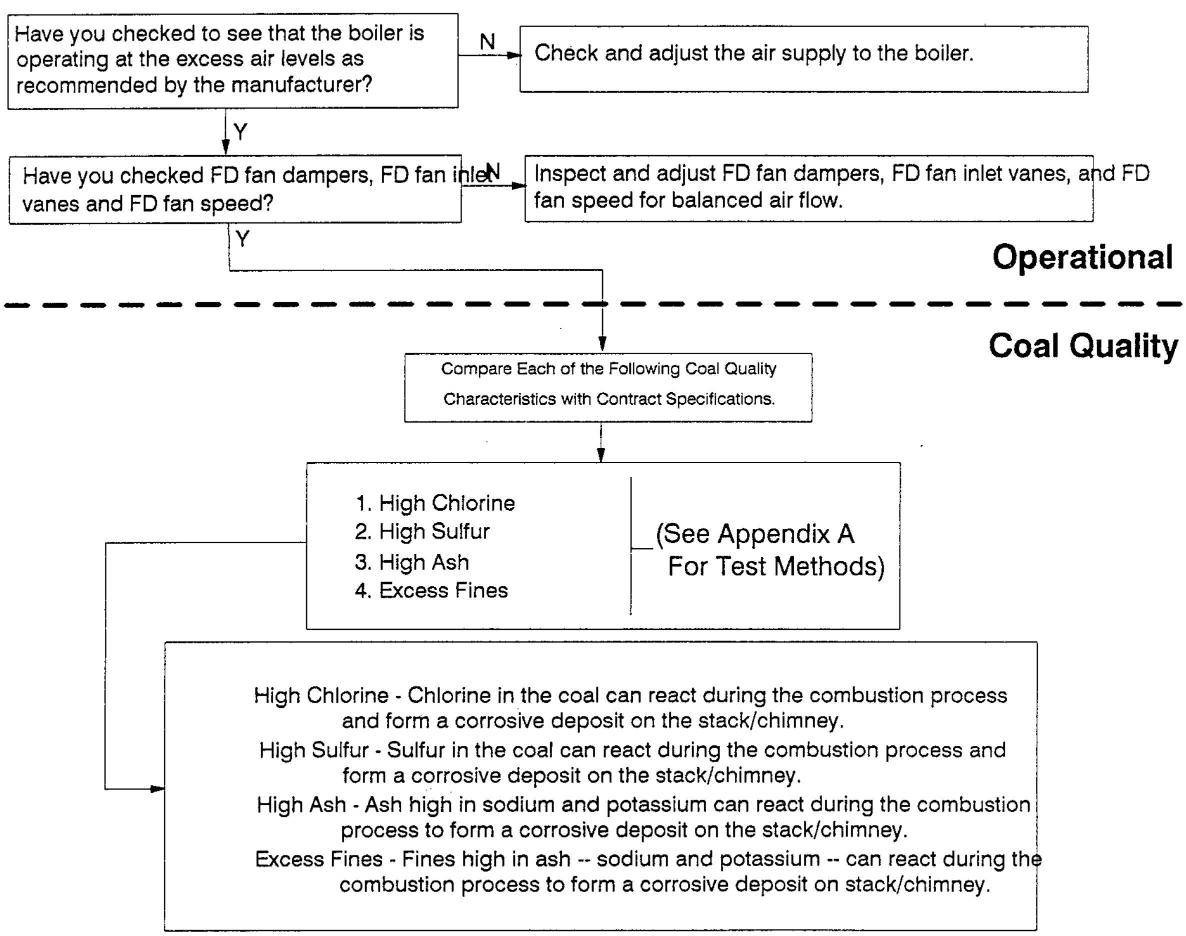
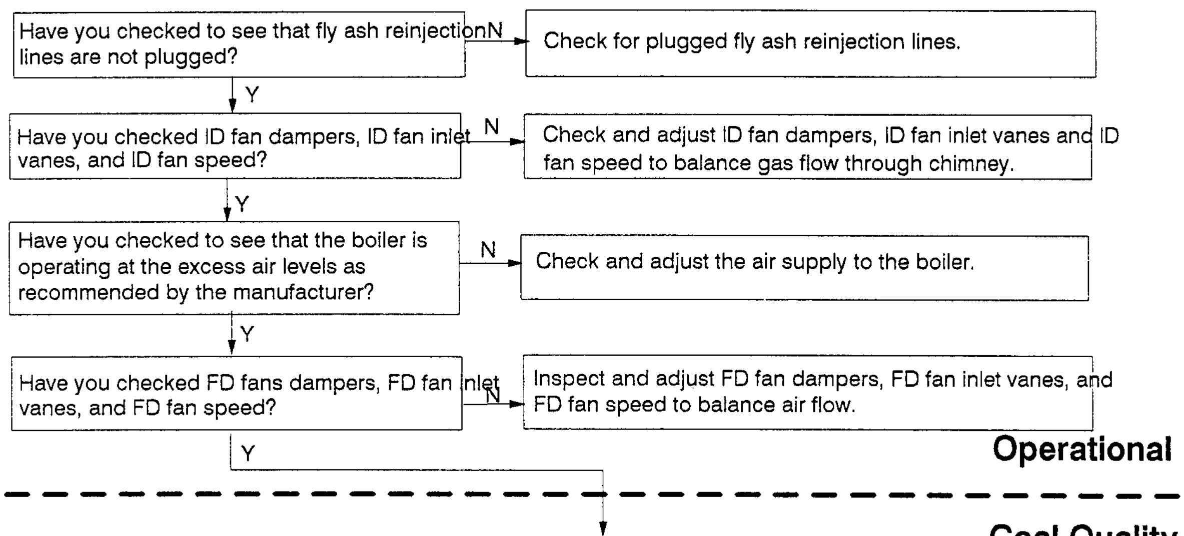


FIG6-84n/3

FIGURE 6-85: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Carbon Burnout In The Stack/Chimney



See next page for the Coal Quality Section.

FIG6-85n/3

RE 6-85 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Carbon Burnout In The Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. High Fixed Carbon
2. Low Volatile Matter
3. Excess Fines
4. High Moisture

(See Appendix A For Test Methods)

High Fixed Carbon - If excessive and there is an insufficient supply of oxygen in the furnace to react with the carbon high combustible losses can result.

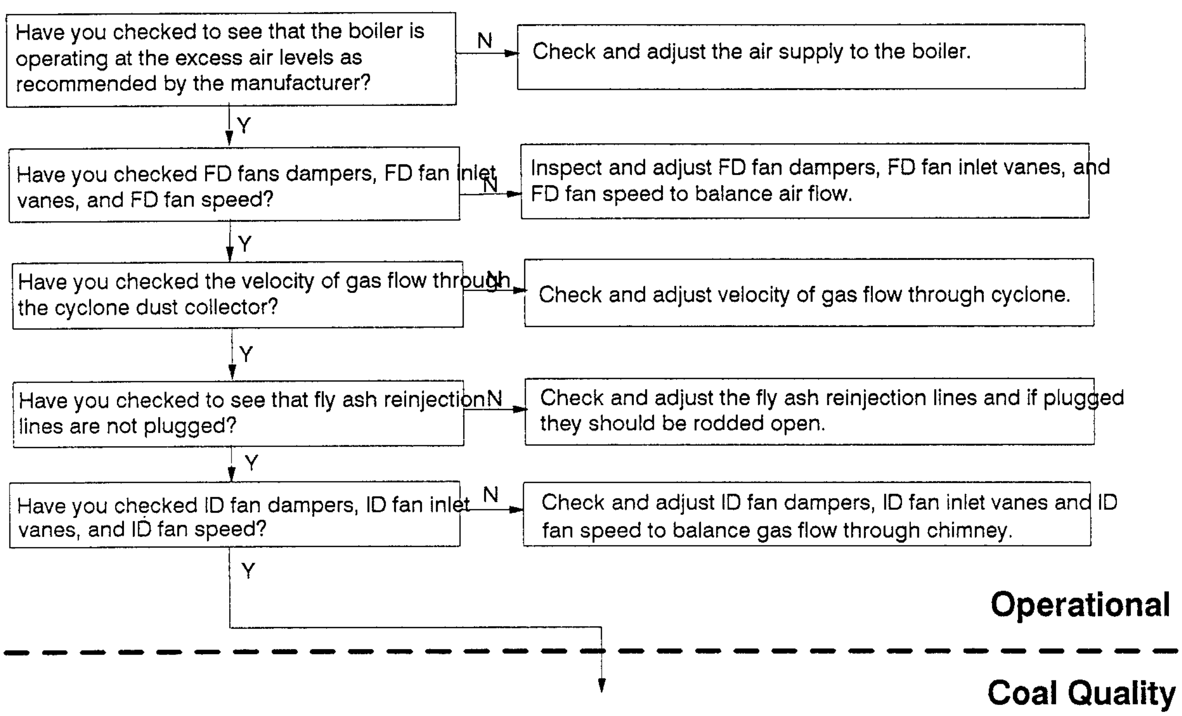
Low Voatile Matter - Because the volatiles help to ignite the coal, a coal low in volatile matter will not produce enough heat to ignite the coal.

Excess Fines - Too many fines can lead to high particulate loadings because they are easily carried out of the furmace and high combustible losses because the particulate loadings carry carbon out of the furnace.

High Moisture - The more moisture there is, the longer it takes for the coal to heat to its ignition temperature, and therefore the harder it is to ignite the coal.

FIG6-85nb/3

FIGURE 6-86: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM
For Smoking From Stack/Chimney



See next page for the Coal Quality Section.

FIG6-86n/3

RE 6-86 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG
For Smoking From Stack/Chimney

See Operational Section on previous page.

Operational

Coal Quality

Compare Each of the Following Coal Quality Characteristics with Contract Specifications.

1. Low Fixed Carbon
2. High Volatile Matter
3. High Ash
4. High Moisture

(See Appendix A For Test Methods)

Low Fixed Carbon - If the carbon in the coal is slow to react with oxygen, tiny carbon particles leaving the flame can give rise to smoke.

High Volatile Matter - If the volatiles are heated very rapidly and are slow to mix with oxygen, tiny carbon particles can leave the flame giving rise to smoke.

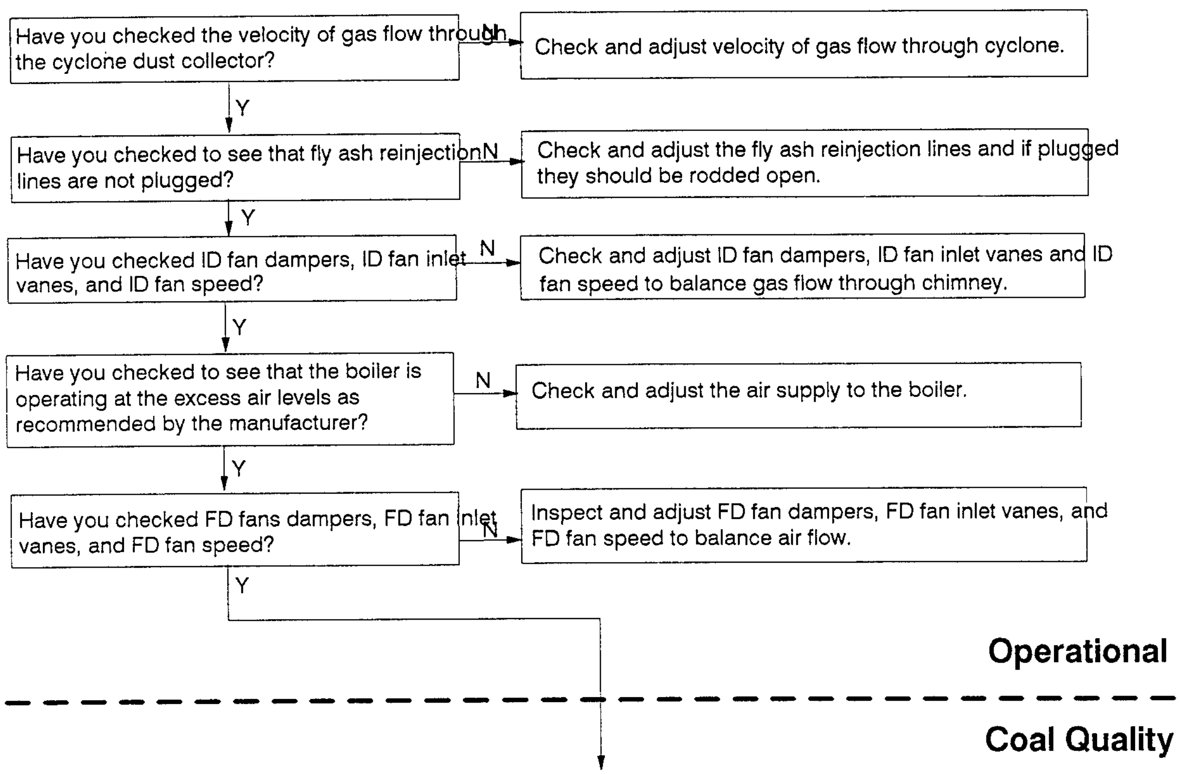
High Ash - Ash particles carried along with the flue gas may contain some carbon particles giving rise to smoke.

Low Moisture - Dry fine coal particles containing tiny unburned carbon particles can get carried along with the flue gas giving rise to smoke.

FIG6-86nb/3

FIGURE 6-87: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For Diagnosing Excess Particulate Emissions From The Stack/Chimney



See next page for Coal Quality Section.

FIG6-87n/3

RE 6-87 (CONT'D): ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAG

For Diagnosing Excess Particulate Emissions From The Stack/Chimney

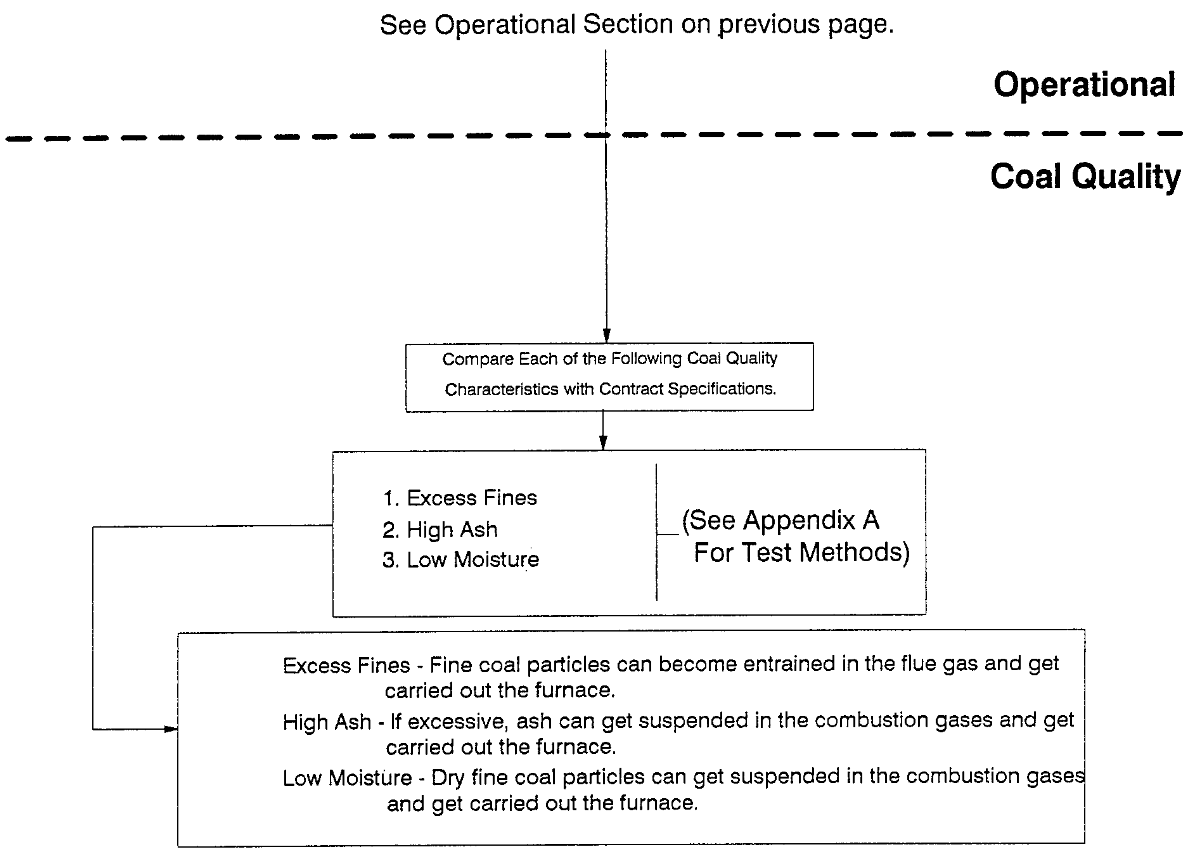


FIG6-87nb/3

FIGURE 6-88: ATMOSPHERIC FLUIDIZED BED TROUBLESHOOTING LOGIC DIAGRAM

For SO_2 Emissions From The Stack/Chimney

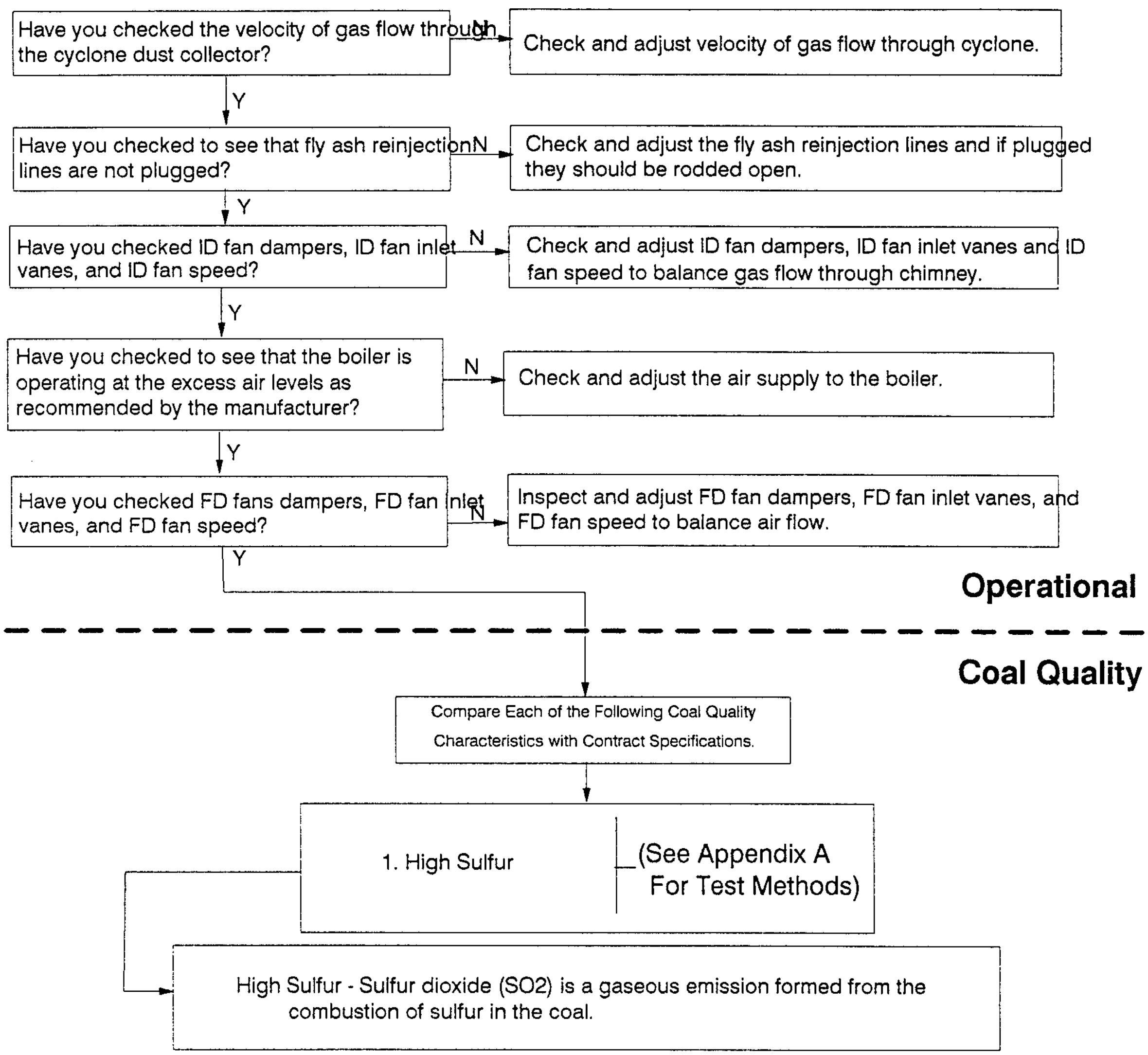


FIG6-88n/3

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